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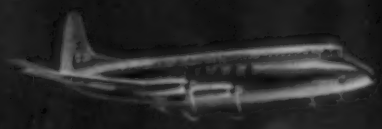

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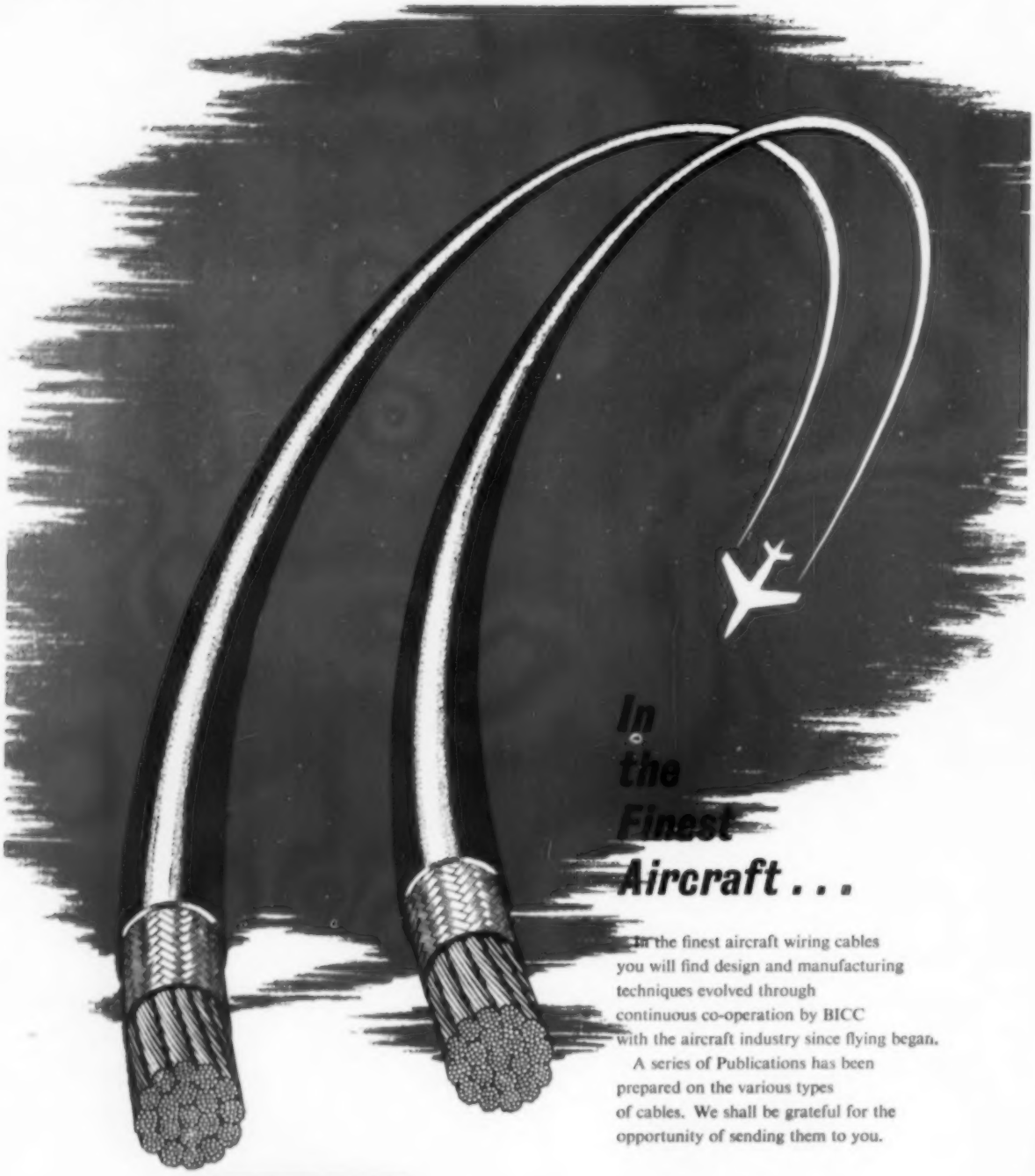

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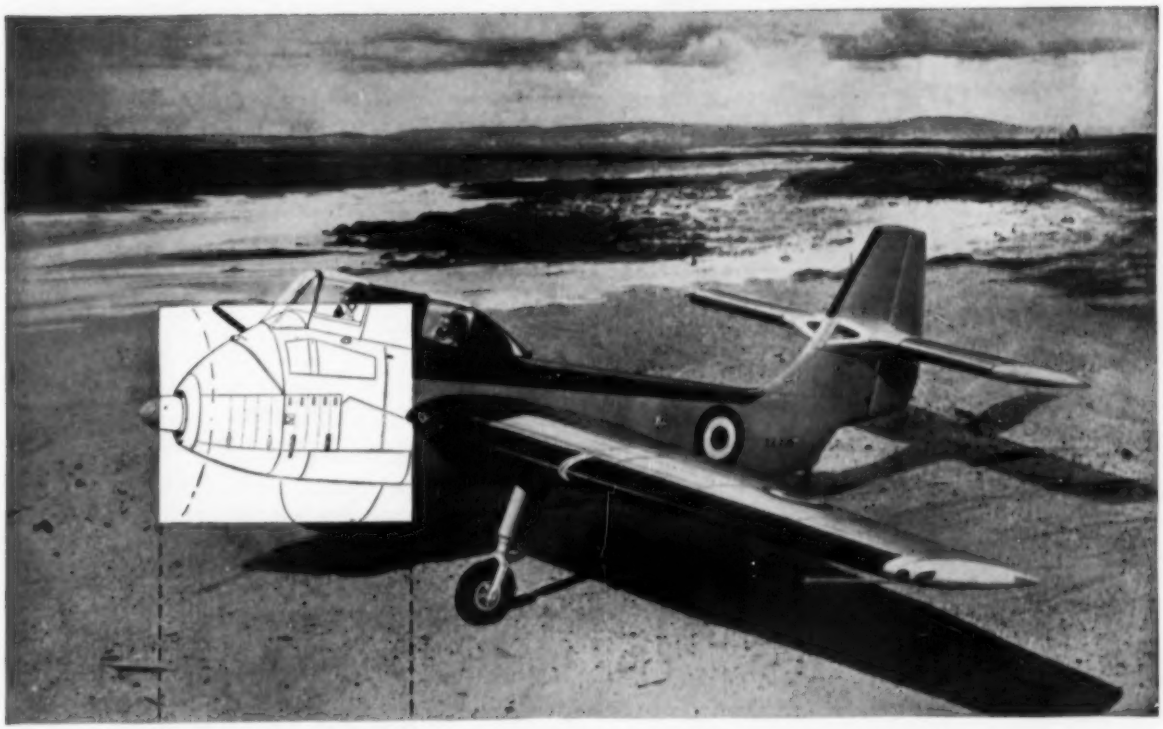

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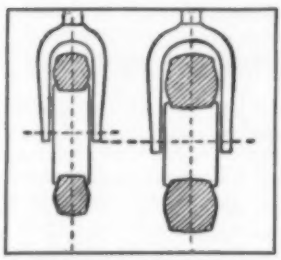
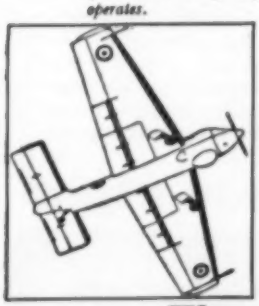


*The wheels of the Seamew can be swiftly changed, with differing sizes of tyre to suit the surfaces from which it operates.*



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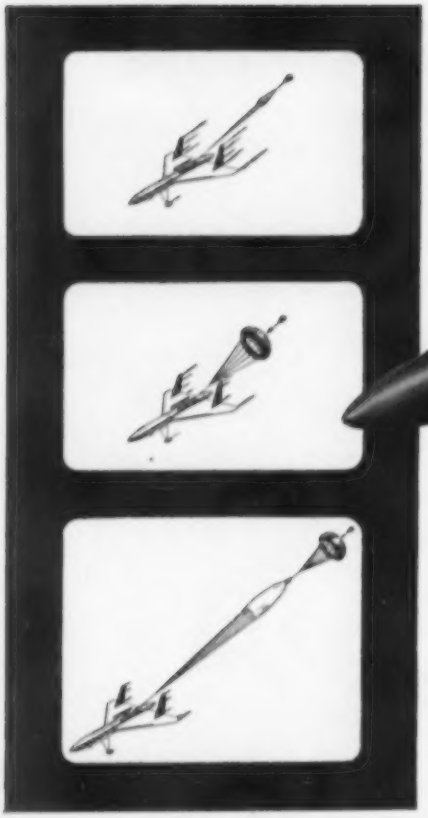

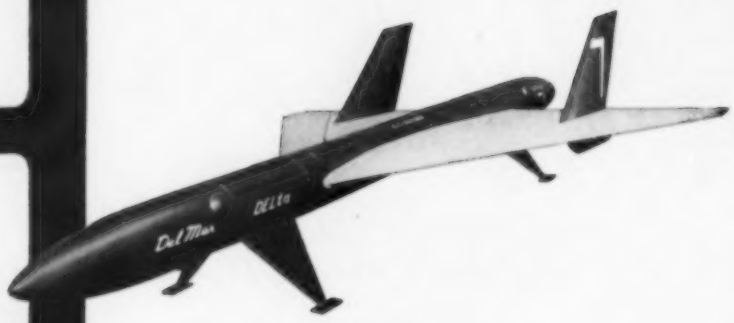


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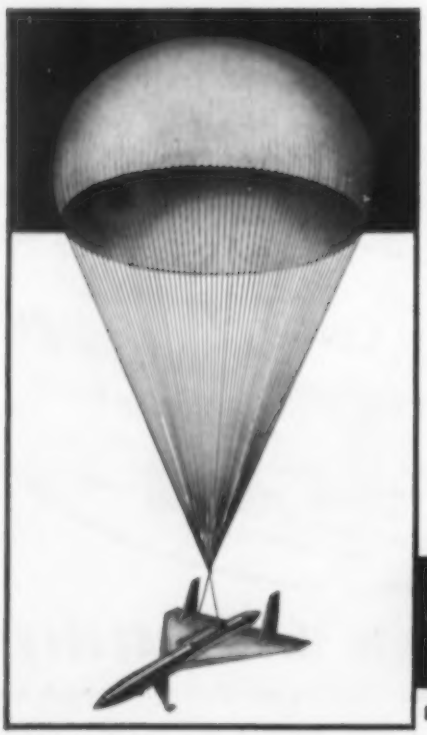

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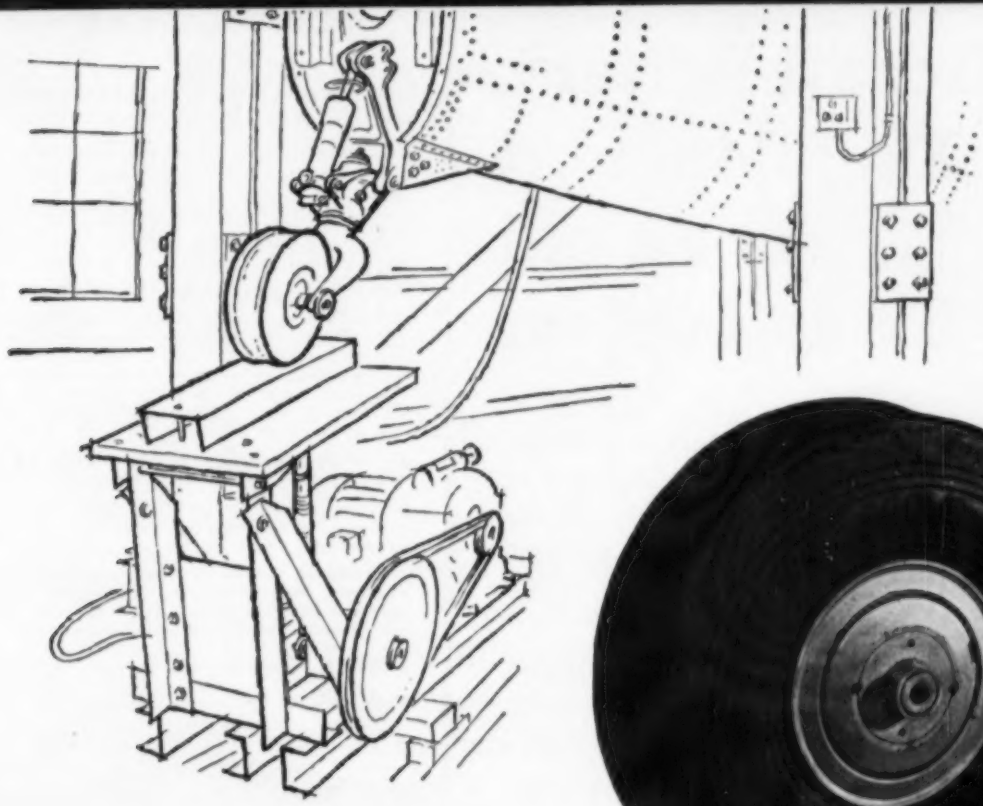

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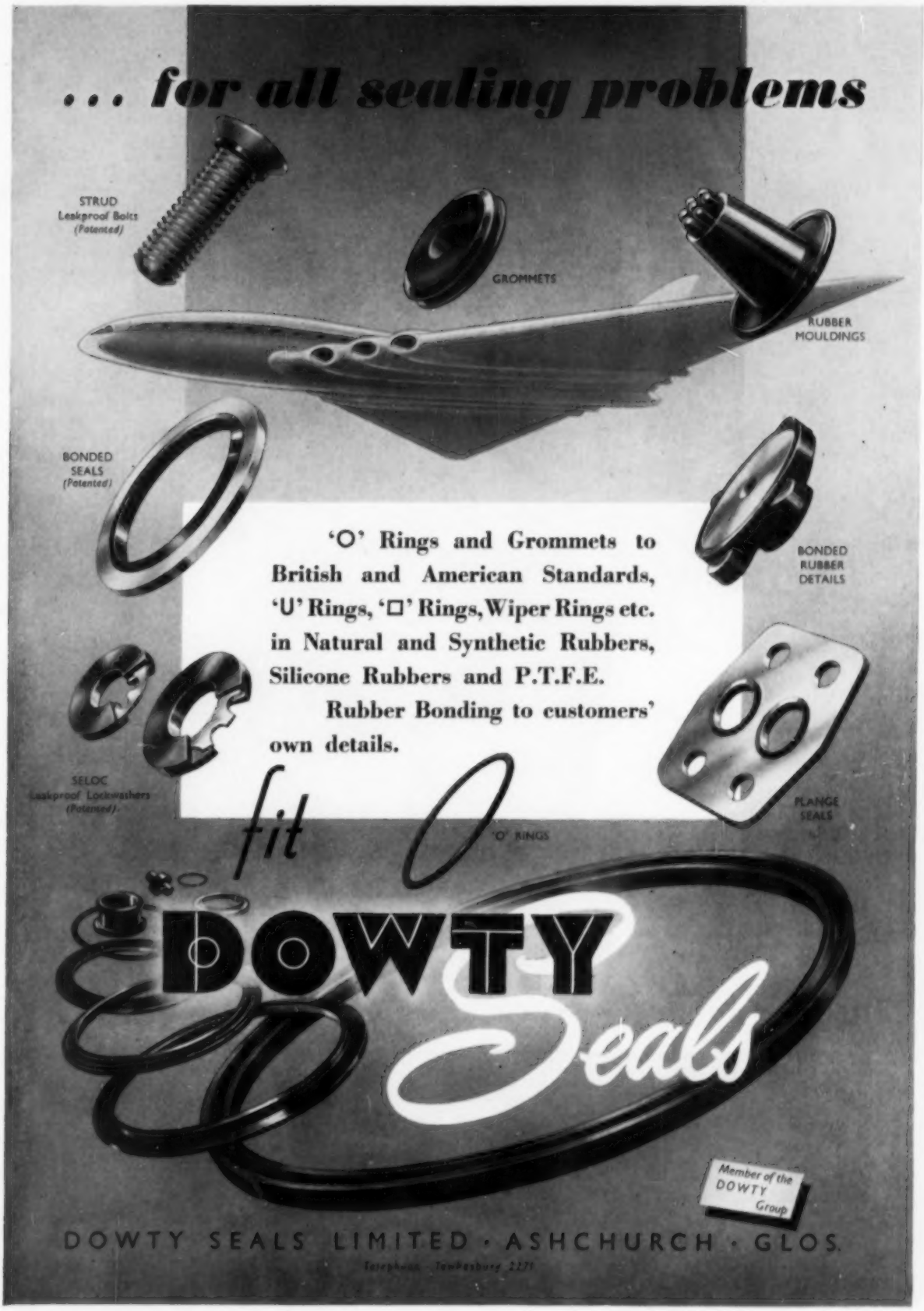
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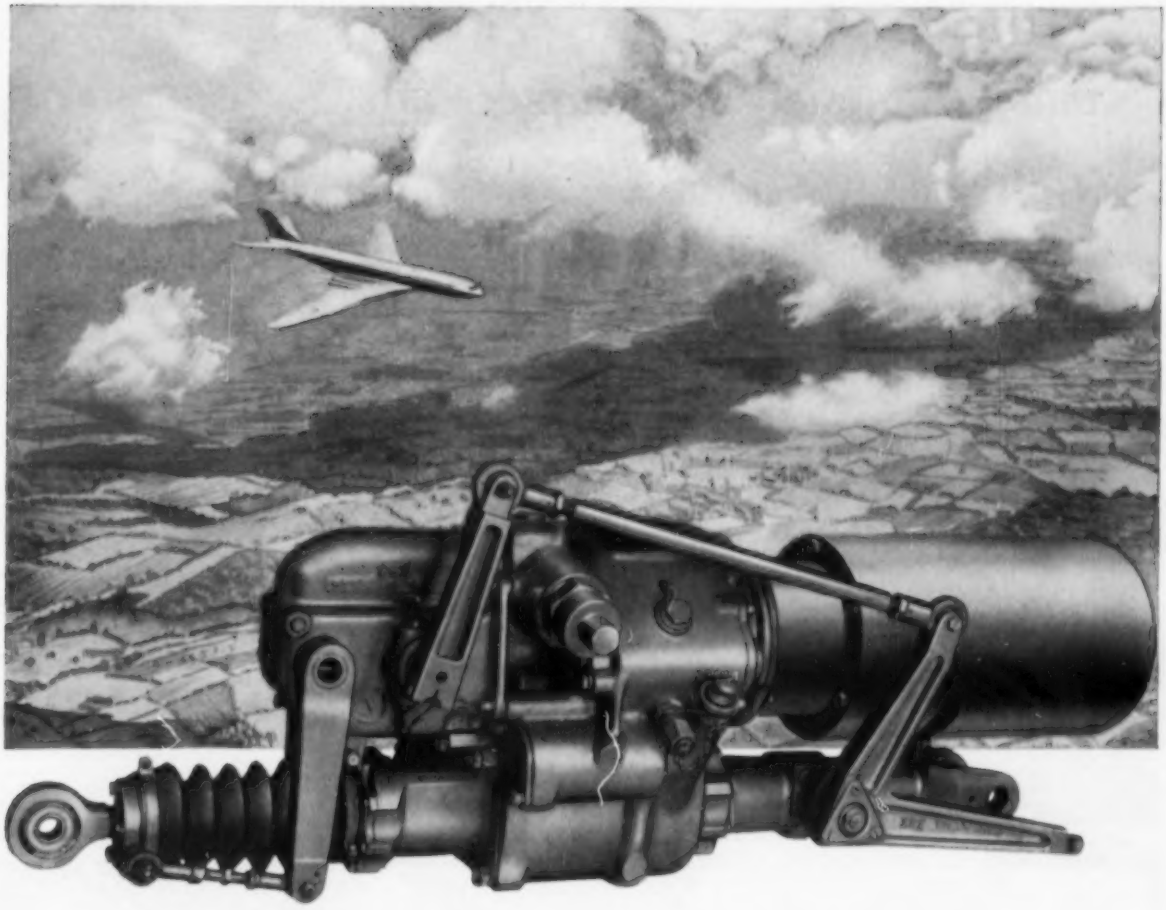

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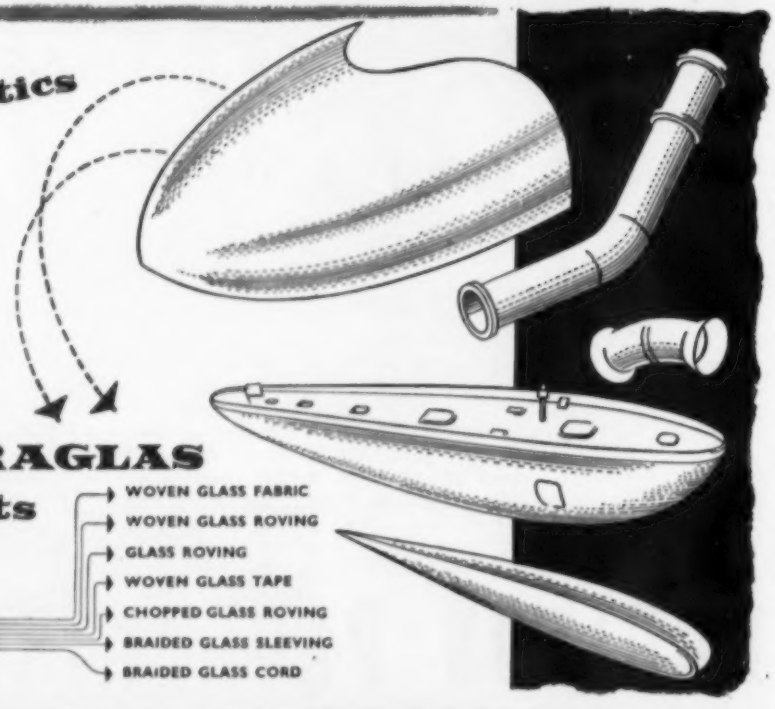

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# MR. PITT BUILDS THIS YEAR'S FLATS ... AND NEXT YEAR'S AIRLINERS

As an architect with an international reputation, Mr. Pitt naturally does a lot of flying. And because he invariably flies British, Mr. Pitt is responsible for more building than he knows! For example. His fares help to buy more British airliners—like BEA Viscounts and Elizabethans. Help to pay the men who design and build new airliners. And help pay BEA technicians to lend advice from the operational (and passenger's) point of view. In fact, without people like Mr. Pitt (*and nearly 2 million others who flew BEA last year*) the experts who have put Britain's aircraft industry ahead would get nowhere. But while Mr. Pitt (and all the others) keep on flying British, British Civil Aviation will keep on flying ahead.

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and
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First Aeronautical Weekly in the World

Founded 1909

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## Cause for Congratulations

FIFTY thousand pounds—the profit earned by British European Airways in their latest financial year—is little more than a drop in the modern airline's ocean of expenditure. But though the sum itself is not of great account, it does mark an important change in the Corporation's affairs—the transition, we may confidently hope, into an era of truly competitive and healthy operation. B.E.A.'s executives and staff have worked long and hard for this moment, and are to be congratulated on beating last year's expenditure budget by so handsome a margin.

Hard work and good planning are not, of course, the only factors behind the airline's success. Dependability and economy of equipment are equally essential; and in this respect the performance of B.E.A.'s Viscounts has been most impressive. Anyone who spends a few hours in the vicinity of London Airport has the opportunity to admire these splendid machines as they carry the British flag to and from Continental cities.

Such an opportunity came our way last week-end, when we chanced to see among the swarm of London air traffic the first Capital Airlines Viscount—a gleaming vision in white, silver and scarlet, trying its wings over the Surrey countryside on an early flight-trial. It reminded us of another, less-publicized achievement of B.E.A.—in the rôle of salesman for the first turboprop airliner (scoreboard to date: 200). Without B.E.A.'s original contract, it is doubtful whether the type would have reached the market; most orders for 700-Series Viscounts depended to some degree on the development work performed by the Corporation, and other companies may also follow B.E.A.'s lead in ordering the enlarged Viscount Major. Though it can never be shown in the airline's accounts, these facts are worth keeping in mind when considering the past two or three years' profit-and-loss figures.

The Capital Viscounts will soon be piling up flying hours on U.S. inter-city routes. It is a sobering thought that these aircraft are likely to earn more profits for their operators than will European Viscounts, even though airliners in American domestic service yield less money per flying hour than in Europe.

### Room for Improvement

This paradox was most competently investigated and explained by the Air Research Bureau, an organization set up in 1952 by six European airlines. One of the Bureau's reports conceded that airline operators in Europe encountered many restricting influences unknown to American domestic carriers, but insisted that some ways of decreasing European costs had not been fully exploited; and, furthermore, it predicted that air transport on this continent would not develop as it has done in North America until cost-reduction made it possible to reduce fares to well below their present level. Certainly there is no denying that air travel within Europe is still far too expensive. The American flies for an average of less than 5d. per mile, compared with the 7d.-10d. paid by the less affluent European.

Among the factors which restrict traffic and increase operators' costs in Europe are Customs barriers; non-convertibility of currency; public reluctance to travel at off-peak hours; and high fuel costs and landing fees. Seasonal traffic-variations also are generally more pronounced in Europe than America; the drop from summer peak to winter trough is probably the most acute of B.E.A.'s problems.

Despite all these difficulties, certain aspects of European air transport are not beyond the operators' powers of improvement. Utilization is one obvious instance; it is quite usual for American, Canadian or Australian airlines to work an aircraft twice as hard as European operators using similar machines over corresponding stage-lengths. Productivity of employees, also, is generally lower in Europe.

Perhaps the greatest weakness of European airlines is the tendency to operate services which suit the carrier rather than the customer. All too often the requirements of local traffic are subordinated to those of the main trunk routes. The value of frequency, in particular, does not seem to be fully appreciated. It is significant that B.E.A.—more deeply concerned with these questions than any other airline—are at last showing renewed interest in finding a replacement for the DC-3.

# FROM ALL QUARTERS

## Viscount Orders Exceed 200 . . .

ORDERS announced by Vickers-Armstrongs last week brought the total number of Viscounts sold to 200. On May 12th the total reached 189 when (as forecast in *Flight* for February 25th), it was announced that Union of Burma Airways had ordered three Viscount 700Ds for delivery in the first half of 1957. Valued at £900,000, including initial provision for spares, the order may well lead to further sales in south-east Asia.

The following day B.E.A. and Vickers jointly announced further orders for 11 Viscounts, for delivery in 1957. This contract brings B.E.A.'s total Viscount purchases to 49 aircraft—27 Type 701s and 22 Type 802 "Viscount Majors." This latest order is for ten Majors and an additional Type 701 to replace the Elizabethan recently damaged beyond repair in a forced landing.

Designed specifically to meet B.E.A.'s short- and medium-range requirements, Viscount Majors will have an extended fuselage to accommodate up to 65 passengers. It is estimated that on chosen routes it will operate at seat-mile costs 15 per cent below those obtained with 701s.

Including spares, the total value of the 200 Viscounts is in the region of £56m, of which £40m represents export trade. Of the export sales, 86 aircraft and spares have earned $91.5m from Canada and the United States.

On Tuesday it was revealed that a definite Viscount order from an unspecified operator had brought the total sold to over 200, and that "firm negotiations" might raise it to 250. K.L.M. have been mentioned as likely customers.

## . . . and Many More to Come

"ALL Martin 4-0-4 and Convair operators are potential Viscount customers . . . total sales of the Viscount could eventually reach 600." These are the opinions not of a Vickers sales representative but of an American airline executive—Mr. J. H. Carmichael, who, as president of Capital Airlines, took delivery last Tuesday of the first of 60 Viscounts ordered by his company.

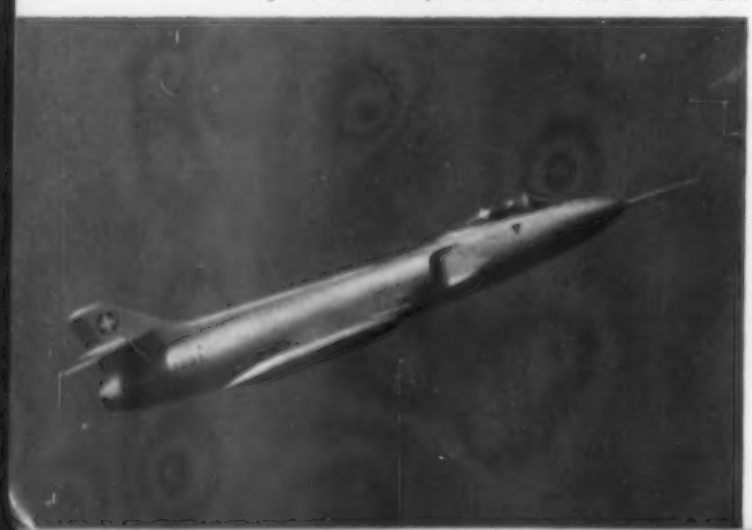
On the eve of the ceremony, which took place at Wisley, Mr. Carmichael told us that Capital hoped to introduce the Viscount on the Washington-Chicago route in mid-July (or, at the very latest, on August 1st), using an initial fleet of three aircraft. Two more were due for delivery in September and by the end of the year the delivery rate would be building up to four per month. The entire fleet of 60 should be in Capital's hands by February 1957.

By the end of 1955 the airline expects to achieve a utilization of 8½ hours per aircraft per day. Present average fleet utilization of Capital's Constellations, DC-4s and DC-3s is 10 hr 20 min. Estimated break-even load factor for the Viscount is 50.6 per cent, and this figure is already being handsomely exceeded by Capital's existing fleet—though some of their competitors have more competitive equipment.

On the Chicago-Washington stage, which ranks third in importance among U.S. domestic routes, the Viscount will be competing with DC-7s and Super Constellations. "Slim" Carmichael is confident that the turboprop airliner will offer better schedules and has no doubt about its ability to pull in a bigger share of the traffic. He "could not be happier" about the results already achieved by T.C.A.'s Viscounts on the competitive Toronto-Montreal route. According to Mr. Carmichael, the American domestic airlines are showing an increasingly serious interest in the Viscount. In his opinion a comparable turboprop airliner of American manufacture will not be available for delivery much before 1960-1961.

The first phase of Capital's efforts to promote turboprop travel in America has been very successful. In Pittsburg, for example, there have been over 600 applications to fly in the new aircraft. Already there is sufficient public interest to guarantee 100 per cent loads on the initial services. A second phase will be a 25-day demonstration tour of American cities by Capital's first Viscount. Finally, a major promotional effort will be made towards the end of the year as the delivery-rate builds up.

*H.R.H. THE DUKE OF EDINBURGH at the controls of the D.H. Devon in which he flew to Speke Airport, Liverpool, in order to visit the laboratories of the British Rayon Research Association near Manchester.*



*ALPINE ATTACK is the intended rôle of the F.F.A. P-16 prototype, the first Swiss-designed jet aircraft (below). Powered by a Sapphire, the P-16 is intended eventually as a replacement for the Vampire and Venom; a drawing and notes were published in our issue of March 25th.*

## Another Super-carrier

UNDER its new ship-building programme recently authorized by the House of Representatives, the U.S. Navy will build a fifth *Forrestal*-class carrier, to be named *Kitty Hawk*. The vote for this ship is £71,500,000 exclusive of aircraft. The *Forrestal* itself is now fitting out and will commission within a year, and the *Saratoga*, the second ship, is due for launching late in October.

The total ship-building vote exceeds £470m and provides for a fiscal year beginning on July 1st, 1955. In addition to the new super-carrier, the programme provides for considerable modification of existing carriers and also for the construction of three more nuclear-powered submarines, three guided-missile frigates and the conversion of a light cruiser and destroyer to guided-missile armament.

## Lufthansa on Schedule

THE first German commercial flight between England and Germany since 1939 was made last Monday by a Convair of the new Deutsche Lufthansa. It landed at London Airport from Frankfurt with a party of German journalists on board.

At a reception at the Airport, to mark the occasion, Sir George Cribbett, Deputy Secretary of the Ministry of Transport and Civil Aviation, welcomed the German operators to London. Replying, Herr H. M. Bongers, chief executive of Lufthansa, expressed the hope that the new air link between England and Germany, now to be operated jointly by B.E.A. and Lufthansa, would bring about an increase in passenger traffic. He stated also that by next year his company intended to increase its transatlantic services to 12—ten to the U.S.A. and two to South America: other services would extend into the Middle East. (Details of these plans are given in an article in this issue, describing a proving flight with D.L.H.; it begins on page 697.)

## B.E.A. Out of the Red

BRITISH EUROPEAN AIRWAYS' persistent efforts to reduce costs and increase traffic have been finally rewarded by the achievement of a net annual profit, for the first time in the airline's eight-and-a-half years of operation. The profit figure for the financial year 1954-55—announced in London last week—is £52,000. This remains after paying all costs and finance charges, including £654,000 interest on capital and providing over £1,500,000 for amortization and depreciation.

The Corporation had originally budgeted for a loss of about £1m during the year. An intensive sales drive, coupled with the passenger-attractiveness of Viscounts and Elizabethans, however, had resulted in a £¼m increase in revenue, while strict economies had resulted in the expenditure budget being beaten by £¼m. This latter fact was stated by Mr. Peter Masefield, chief executive, to be the basic reason for the profit, the gross value of which (i.e., before meeting finance charges) was approximately £¼m.

During the year ended March 31st, 1955, B.E.A. carried more than 54 per cent of all traffic leaving the United Kingdom for European destinations. Compared with the previous year's results, the traffic carried by the Corporation increased by 19 per cent, for an increase in cost of only four per cent. Revenue earnings increased by 17 per cent and, while the revenue load-factor moved up one point to 65 per cent, the break-even load factor was significantly reduced from 70 to just under 65 per cent. Provisional figures in more detail are given in the table below.

| | 1954-55 | 1953-54 | Percentage Variation |
|---|---|---|---|
| Total revenue ... ... | £17,205,000 | £14,773,000 | +17 |
| Total expenditure ... ... | £17,153,000 | £16,547,000 | + 4 |
| Net profit ... ... ... | £52,000 | (£1,774,000 loss) | |
| Capacity ton-miles offered ... | 98,331,000 | 83,593,000 | +18 |
| Load ton-miles sold ... ... | 63,647,000 | 53,595,000 | +19 |
| Revenue load-factor (per cent) | 64.8 | 64.1 | + 1 |
| Passengers carried ... ... | 1,874,000 | 1,657,000 | +13 |
| Passenger miles flown ... | 577,078,000 | 480,065,000 | +20 |
| Passenger load-factor (per cent) ... ... ... | 68.5 | 66.3 | + 2 |
| Freight ton-miles sold ... | 5,728,000 | 5,557,000 | + 3 |
| Mail ton-miles sold ... ... | 2,919,000 | 2,601,000 | +12 |

On the occasion of the announcement of the Corporation's profit, Lord Douglas, the chairman, disclosed that he had had discussions with Sir Brian Robertson (Chairman of the British Transport Commission) concerning a possible spur railway line between Feltham and London Airport Central, and a proposition to this effect had been put to the Minister of Transport and Civil Aviation.

Referring to future fleet plans, and in particular to the concept of a DC-3/D.H. 89 replacement, Mr. Masefield said that B.E.A. were engaged in studies of the proposed requirements for such an aircraft. A specification to manufacturers would follow. No existing aircraft satisfied the Corporation's requirements, the chief executive stated, and "We are definitely not interested in another piston-engined type." Power for the proposed aircraft, Mr. Masefield suggested, would preferably come from four small turboprops (such as the Artouste) or possibly two Darts; the machine should have about 26 seats; and B.E.A. would require some 12 such aircraft in about 1961. Low fuel-cost and increased safety were the main reasons for favouring turbine engines.

## O. P. Jones Steps Down

AFTER nearly 40 years of flying, 33 of which have been with B.O.A.C. and its predecessors, Capt. O. P. Jones, C.V.O., O.B.E., F.R.G.S., A.F.R.Ae.S., has decided to retire from active piloting of the Corporation's aircraft; he is 56 years of age, and is their most senior pilot. The Corporation will not, however, be deprived of his experience, for he is to continue in their service "as lecturer, guide, philosopher and friend."

*Capt. O. P. Jones.*

"O. P." served in the Royal Engineers, R.F.C. and R.A.F. between 1916 and 1919, learning to fly in 1917. After the war he joined F. J. V. Holmes (now of Tiltman Langley, Ltd.) in a joy-riding venture known as Berkshire Aviation Tours, which between 1920 and 1922 carried 12,000 passengers. After that he joined the Instone Air Line, since when he has been continuously engaged as an airline captain on European, international and empire routes. His career can be summed up by saying that he has flown 21,600 hours on 100 types of aircraft and made more than 6,000 crossings of the English Channel and 300 of the Atlantic. He has carried something like 140,000 passengers, and among them have been many distinguished personages. He made some of the earliest royal flights when he flew the then Prince of Wales between Paris and London in 1926 and 1929, and in 1951 he took Queen Elizabeth (then Princess Elizabeth) and the Duke of Edinburgh to Canada.

At a London meeting of the B.O.A.C. Board last week, Sir Miles Thomas, the chairman, presented Capt. Jones with an illuminated certificate recording the Board's "deep appreciation of this long and faithful duty in their service."

***ROYAL INSPECTION**: Another of the numerous visits to scientific and commercial establishments paid by the Duke of Edinburgh during recent weeks was to the Fernhurst Research Station of Plant Protection Ltd. (an I.C.I. subsidiary) at Haslemere, Surrey. Here he watched a demonstration of orchard-spraying by an Auster.*

## U.S.A.F.'s "Open Day"

TOMORROW, Saturday, May 21st, is United States Armed Forces Day, and a number of U.S.A.F. bases in various parts of the British Isles will be open to the public. The period of admission is, we understand, approximately 9 a.m. to 5 p.m. and admission will be free, as will car parking. The exhibits on view will, in general, illustrate the everyday work of each station, and at a number of airfields visitors will have the opportunity of seeing the aircraft based there.

Airfields open will be as follows: *Bentwaters*, nr. Ipswich, Suffolk; *Brize Norton*, nr. Witney, Oxon; *East Kirby*, nr. Skegness, Lincs; *Fairford*, nr. Cirencester, Glos; *Lakenheath*, nr. Thetford, Norfolk; *Manston*, nr. Ramsgate; *Molesworth*, Huntingdon; *Prestwick*, Ayrshire; *Sculthorpe*, nr. Fakenham, Norfolk; *Shepherd's Grove*, nr. Bury St. Edmunds, Suffolk; *Sturgate*, Lincs; *Upper Heyford*, between Oxford and Banbury; and *Wethersfield*, nr. Braintree, Essex.

In addition, there are a number of U.S.A.F. bases at which administrative, technical and other work takes place but at few of which, if any, are aircraft likely to be seen. These are as follows: *Burderop Park*, Wilts; *Bushey Hall*, Herts; *Bushy Park*, Middx; *Blyton*, Lincs; *Denham*, Bucks; *Greenham Common*, Berks; *Langham Camp*, Norfolk; *West Drayton*, Middx; *Wimpole Park*, Cambridge.

## Women Pilots Get Together

AT the request of a number of women pilots, the Women's Engineering Society—who administer the Amy Johnson Memorial Fund—have decided to form an organization under the title of the British Women Pilots' Association. Aims and objects, in brief, are to promote the training and employment of women in aviation; to promote schemes to assist women to gain licences; to give advice on training and employment; to provide opportunities for women to meet and exchange aviation knowledge of mutual interest; to express the collective opinion of members; and to promote interest in, and further the cause of, aviation in general.

Two grades of membership are proposed: full membership, open to women pilots who hold or have held at least a private pilot's licence or "C" certificate in gliding, and other feminine aircrew holding the appropriate licence. Associate membership is

## FROM ALL QUARTERS . . .

open to women training for such licences and to those interested in furthering the Association's aims.

The chairman is Miss Freydis Leaf, who was last year's air racing champion, and the vice-chairman is Mrs. Monique Rendall; Miss Janet Ferguson is hon. secretary, and Miss Anthea Williams hon. treasurer.

It is proposed to make the Women's Junior Air Corps rally at White Waltham on Whit Monday the first flying event in which the Association will take part. Details of membership are obtainable from the hon. secretary of the B.W.P.A. at the headquarters of the Women's Engineering Society, 45, Eastcastle Street, London, W.1.

### Plastics Exhibition and Convention

IN a little over a week the third British Plastics Exhibition and Convention (June 1st-11th) opens at Olympia. This year's show promises to be on an even larger scale than that of 1953, which was attended by buyers from over fifty countries.

At the Convention, 20 papers will be read. Full details of the titles and lecturers were given in *Flight* of March 25th, but the following is a condensed list of dates and subjects:—

(1) June 2nd, a.m. *Polymer structure and properties* (1)—Synthesis of new polymers. (2) June 2nd, p.m. *Polymer structure and properties* (2)—Irradiation of polymeric materials; polythene molecular weight and properties. (3) June 3rd, a.m. *Expanded plastics.*—Blowing agents and processes; technology of polyurethane. (4) June 3rd, p.m. *Thermoplastics.*—P.T.F.E. dispersions; new nylon polymers and compositions. (5) June 6th, a.m. *Extrusion.*—Fundamental problems of single screw extruders. (6) June 6th, p.m. *Work study.*—Application of work study to plastics processes, and the effect on productivity. (7) June 7th, a.m. *Injection moulding* (1)—Effect of variables on the quality of injection mouldings. (8) June 7th, p.m. *Injection moulding* (2)—Recent advances in injection moulding technique and evaluation of an injection moulding material; injection mould design. (9) June 8th, a.m. *Patents*—Patent law and the filing of patents in plastics, in Britain and abroad. (10) June 8th, p.m. *Foundry resins*—Development in the use of plastics in the foundry. (11) June 9th, a.m. *Glass reinforced plastics* (1)—Consistency in moulding; possibilities in the motor industries. (12) June 9th, p.m. *Glass reinforced plastics* (2)—Chemical resistance of glass-reinforced materials; testing and specifications; epoxide resin glass laminates.

Tickets for both the Exhibition and Convention are obtainable free, from The Manager, British Plastics Exhibition, Dorset House, Stamford Street, London, S.E.1., the name of the applicant's firm being included and the convention sessions for which tickets are required being specified.

In connection with the show the journal *British Plastics*—which is organizing the show, with the co-operation of the British Plastics Federation—is publishing a special show guide number on June 1st, giving the fullest possible information about the exhibition, and providing a useful work of reference to the plastic industry's latest materials, products, plant and equipment. A show report issue will appear on July 15th.

# A Triumphant British Picture

BEFORE Princess Margaret and a distinguished audience, the long-awaited film *The Dam Busters* had its première, in aid of Service charities, at the Empire Theatre in London last Monday evening; and so heavy had been the applications for seats that the "first night" was extended to Tuesday evening also, when the Duke and Duchess of Gloucester had consented to attend.

Most of the general-release films which come our way are easy to review; words of criticism are rarely difficult to find, and the majority of air-war films are not only indifferent in their technical accuracy but treat their subjects with the familiar Hollywood approach that effectively prevents the critic from caring very much about either the subject-matter or the outcome. For a change, *The Dam Busters* (an Associated British picture directed by Michael Anderson) comes as a breath of fresh air, carrying the viewer back into the grim and great days of 1942-3, holding him entranced, and leaving him with a strong impression that here, at least, is a film of which Britain can be proud.

Any film telling such a story (it should be noted that the picture is based on Paul Brickhill's best-seller of the same name, together with W/C. Guy Gibson's own *Enemy Coast Ahead*) could hardly fail to be exceptional. But it would have been a tragedy had—as could easily have happened—the company responsible not done their utmost to record what happened. In the event, practically every living person who could materially help in the production was brought in as an adviser; the airfield location scenes were shot at 617's actual base—Scampton—whose war-time commander, G/C. J. N. H. Whitworth, was technical advisor-in-chief during the making of the picture.

The film opens in a particularly pleasant quarter of Surrey, where Michael Redgrave as Dr. B. N. Wallis (who today is Vickers Armstrongs' chief of aeronautical research and development) is obviously engaged in a very 'back-roomish" experiment. To be frank, we had misgivings at this stage: the wife worried at her husband's overwork, the doctor called in ostensibly to examine a daughter but really to check up on Wallis's own health, and other familiar "ploys", could have introduced an indifferent production. Nor are the inventor's struggles with "The Ministry" particularly stimulating, although no doubt accurate enough.

*Dr. B. N. Wallis—a recent photograph—with Michael Redgrave (right), who portrays him as he was twelve years ago.*

*Richard Todd plays the part of the late W/C. Guy Gibson, V.C. (right); this rather film-star-like "still" does not, perhaps, do justice to a convincing characterization.*

Eventually, however, a development contract is awarded, and we see some of the trials off the North Kent shore; this sequence is a genuine one, from the ciné record made at the time. To this extent only is the skipping bomb actually used in the operation revealed; many of its most significant features are not displayed, but its behaviour is clear. It was designed to be dropped on to calm water from a low altitude, when it would skip in a predicted fashion across torpedo nets and other obstructions until it finally hit the dam itself at a much reduced speed; it would then sink against the face of the wall until triggered by a hydrostatic pistol. Early trials of representative weapons were disastrous, and only with difficulty did Dr. Wallis retain support for his conception right through to the eventual successful trial early in 1943.

Considerations of the water-level in the dams (the Möhne, Eder and Sorpe) and the state of the moon pointed strongly to an attack in the middle of May—i.e., exactly a dozen years ago. Air Chief Marshal Sir Arthur Harris, then C-in-C. Bomber Command, picked W/C. Guy Gibson—already an outstanding officer—to form a new squadron, from hand-picked crews, solely to breach the great Ruhr dams.

From this moment on *The Dam Busters* lifts itself head and shoulders above almost any other air-war film which we can recall.

The story of how the Lancasters were modified,* how the crews trained, and how the operation itself fared is by now generally known. [*Continued opposite*

**For the film, this considerable task was performed by A. V. Roe and Co., Ltd.*

*Pupils of several different air forces listen to an instructional talk alongside one of the Harvards still used for basic training at Fürstenfeldbruck, where the most promising of the German pilots will be trained to form an instructional and flight-command nucleus for the new Luftwaffe.*

# LUFTWAFFE REDIVIVUS

## *Germany's New Air Force for A.A.F.C.E.: Its Strength and Constitution*

WITH the West German Federal Republic now a full member of NATO, a new Luftwaffe will soon arise from the ashes of that laid low by Anglo-American air power just a decade ago. But there will be this essential difference: it will not be a completely independent air arm but an integral part of Allied Air Forces Central Europe, just as are the contingents already contributed to A.A.F.C.E. by Britain, the United States, Canada, France, Holland and Belgium.

The character and numerical strength of the prospective new West German Air Force was decided long before the peace treaty was ratified. It is to be a purely tactical force, supplemented by six *Staffeln* (squadrons) of transport aircraft. Total strength will be 80,000 officers, N.C.O.s and airmen and precisely 1,326 aircraft, organised into 20 *Grundeinheiten* (wings), each consisting of three squadrons. The operational units will be equipped with day and night all-weather intercepters, fighters, fighter/bomber ground-attack aircraft, and tactical reconnaissance machines. There will be two wings of all-weather fighters and a similar strength of Tac-R squadrons. The rest will be intercepters and fighter-bombers.

Part will come under the operational control of Air Marshal Sir Harry Broadhurst's 2nd Allied Tactical Air Force, which is now a predominantly R.A.F. force, with Belgian and Dutch contributions; the remainder will be under the American-Canadian-French 4th A.T.A.F. These are the two field components of A.A.F.C.E., of which Air Chief Marshal Sir Basil Embry, former A.O.C-in-C. Fighter Command, is the commander-in-chief, with headquarters at Fontainebleau; 2nd A.T.A.F.'s headquarters are near Munchen-Gladbach, and 4th A.T.A.F.'s at Ramstein, not far from Kaiserslautern.

Full-scale training of the new Luftwaffe is expected to start about September, and the force is likely to be ready for operational duties by the summer of 1958. Preliminary flying and other training will be provided by the United States Government under the Mutual Defence Assistance Programme (M.D.A.P.), but other NATO countries, including Britain, will supply some of the instructors. Conversion training will be the responsibility of the A.T.A.F. to which the wings are assigned. Probably half of the 20 *Grundeinheiten* will be assigned to each of the two Allied Tactical Air Forces. German officers will join the joint planning staff, and the West German Air Force will be administered by the Federal Government.

The first task is obviously to train German instructors, pilots destined for commands, and key technicians. The M.D.A.P. flying training centre is at Fürstenfeldbruck, near Munich, where during the last twelve months about 300 flying instructors and other pilots from most of the M.D.A.P. countries have completed courses. Four experienced R.A.F. pilots were seconded to the Fürstenfeldbruck establishment as staff instructors at the beginning of this year. They are F/L. J. G. F. Hewitt, F/L. R. H. Payne, F/L. D. J. Lomas; and F/O. M. R. Holmes. In preparation for their future duties they have taken a course on T-33s, which are the standard jet trainers there. Harvards are used for basic tuition, and both jet flying and instrument training is given. When they have taken the full course most of the instructors return to pass on their knowledge and skill to their own air forces, but a few are retained as staff instructors at Fürstenfeldbruck.

At Freising, only a few miles away, is the centralized M.D.A.P. school for instructing technicians in electronics, communications, and an American type of early-warning radar. The school is operated by U.S.A.F.E. Eleven different courses are given, ranging in duration from six to 22 weeks. Most of the graduates return to their own air forces as fully qualified instructors but, as at the flying training school, some stay at Freising as staff instructors.

The number of volunteers for service in the revived Luftwaffe is reported to be satisfactory, so that for the present there is no intention of introducing conscription. If and when national service is instituted the period will probably be eighteen months.

An official of an organization called the Aircraft Parts Producers' Association has stated in Frankfurt that Messerschmitt, Heinkel, Focke-Wulf and other German aircraft firms plan to resume production of powered aircraft "after June 1st," but it will clearly be some time before they can produce completely new designs. Meanwhile, the Luftwaffe will use both British and American operational aircraft, though details of types have not yet been announced.

## A Triumphant British Picture (continued from opposite page)

In the result on the screen the whole scene is vividly recaptured, without glamour, without any "wizard prang" characters and without deliberate staging of anything that did not actually happen. The very best use had clearly been made of the limited number of Lancasters available, the impression of a much larger force being cunningly contrived.

Domestic scenes of 617's crews show behaviour exactly as one would recall it, and the same atmosphere of integrity is maintained throughout—a remarkable achievement when it is considered that the slightest bit of "acting" would have been instantly detectable. Unhurriedly, the operation is mounted, and the various forces of Lancasters set forth from Scampton in the twilight, cross the familiar city of Lincoln and set course for the sea. Once over the water some particularly fine photography is presented, the familiar black outlines of the aircraft being rendered curiously portentous by the projecting semi-circles of the Wallis bombs.

The leading formations lift gently across the enemy coast and penetrate far into Holland, almost at tree-top height. Down the canals they fly, and soon they encounter opposition. The flak is the most realistic we have seen, and the end of one Lancaster is also very well done. Similarly excellent "special effects"—plus shots from German newsreels—characterize the attack on the dams themselves, a sequence which must have presented formidable technical difficulties to all concerned.

A good test of any film is whether it seems long or short in relation to its true length; *The Dam Busters* is one of the longest films of recent years (about 11,230ft. of celluloid, taking about 2¼ hr to run), and the attack alone lasts for 40 minutes; yet no part of it drags for a moment.

Altogether, this film is worthy of its subject, than which no more can be said. Richard Todd, as Gibson, and Michael Redgrave, as Wallis, have clearly taken immense pains to create the most faithful portrayal possible of their characters. The former, in particular, does a fine job in taking the part of a remarkable man who has not been with us for 11 years; and it could have been all too easy to present Gibson as Todd, and not to search for the true founder of No. 617. It is in just such matters that this film is outstanding.

*The Dam Busters*, now showing at the Empire, will be generally released on September 5th. W. T. G.

# HERE AND THERE

*VISITING GLOUCESTER for the city's 8th centenary celebrations, the Queen travelled from Norfolk in a Royal Viking, landing at the Gloster Aircraft Company's airfield at Moreton Valence. Before her departure with the Duke of Edinburgh, directors of the company were presented; Mr. P. G. Crabbe (managing director) is seen shaking hands with the Queen and Mr. H. Burroughes (deputy managing director) is conversing with the Duke.*

### Cross-Channel Gliding

THE first two-seater glider flight across the Channel was made last Saturday by Lorne Welch and Frank Irving, in the prototype Slingsby T.42. After taking off from Lasham, Hampshire, at 11 a.m., they flew 250 miles to Louvain, east of Brussels, landing there 5 hr 40 min later. The flight established a new British two-seater distance record, which previously stood at 151 miles (attained by Lorne Welch and his wife Ann, also in the T.42). On the same day, Col. Anthony Deane-Drummond reached a height of 19,000ft—the greatest height gained in England this year—in an Olympia, also from Lasham.

### Stand-by One . . .

COMING in to land at Nouasseur in North Africa after a recent training flight, a B-47 developed undercarriage trouble. Rather than risk a crash landing, the crew set about curing the fault in the air. Thirty-six hours and three air-refuellings later they had carried out repairs and were able to make a good landing.

### More Mothballed Airfields ?

FOR years past the Air Ministry has been experimenting with methods of keeping birds away from airfields, attempted remedies varying from scarecrows to falcons and ultrasonics. Now, it seems, a P/O. J. Irving has discovered that 3 cwt of mothballs distributed over a runway will keep it clear of birds for months. The experiment has been tried at North Weald and at Binbrook.

### Australian Airborne Forces Display

MORE than 30,000 people recently saw a parachute-jumping display by members of the Airborne Platoon of the Royal Australian Regiment at Archerfield Aerodrome, Brisbane. Thirty men gave a spectacular, well-synchronized show, jumping from a Dakota which flew over at 800ft. The display was organized as a realistic battle demonstration, with a "Fantasian" radar control station on the edge of the aerodrome as the objective of the parachutists. The target had previously been "softened" by Canberras.

### Getting Wound Up

FROM a description of a new instrument in an Indian aviation journal:— "The rubber of the plane is automatically controlled by the instrument and one of the dangerous things in blind flying to accidentally go into spin is prevented automatically".

### At the Royal Tournament

R.A.F. participation in the Royal Tournament at Earls Court, London (June 1st-18th) will include a demonstration of the ejection of a dummy pilot from a jet fighter cockpit, and a simulated parachute descent. This year the R.A.F. will also be responsible for the massed bands event; nearly 200 musicians will take part, from the R.A.F. and W.R.A.F. Central Bands, Nos. 1, 3 and 5 Regional Bands, and the R.A.F. Regiment Band.

*VISITING DERBY, and showing obvious enthusiasm for a Rolls-Royce Dart reduction gear and intake casing, is Mr. Robert F. Six, president of Continental Airlines, of Denver, Colorado. On the extreme right is his vice-president, Mr. O. R. Haueter, and the general manager of R-R export sales, Air Marshal Sir Colin Weedon, is between them.*

### Whitsun Flying, Full-scale . . .

SEVERAL air displays are scheduled for Whit-Monday, May 30th; one is the S.S.A.F.A. event at Yeadon, referred to last week, at which the second National Air Race Meeting will be decided; another is the Women's Junior Air Corps display at White Waltham, near Maidenhead (2 p.m., admission 2s, children 1s, cars with occupants 10s); and a third is being held at Weston Aerodrome, Leixlip, Co. Kildare, by the Aero Club of Ireland. On the Continent, the Royal Netherlands Aero Club is holding its big international display at Ypenburg.

### . . . and in Miniature

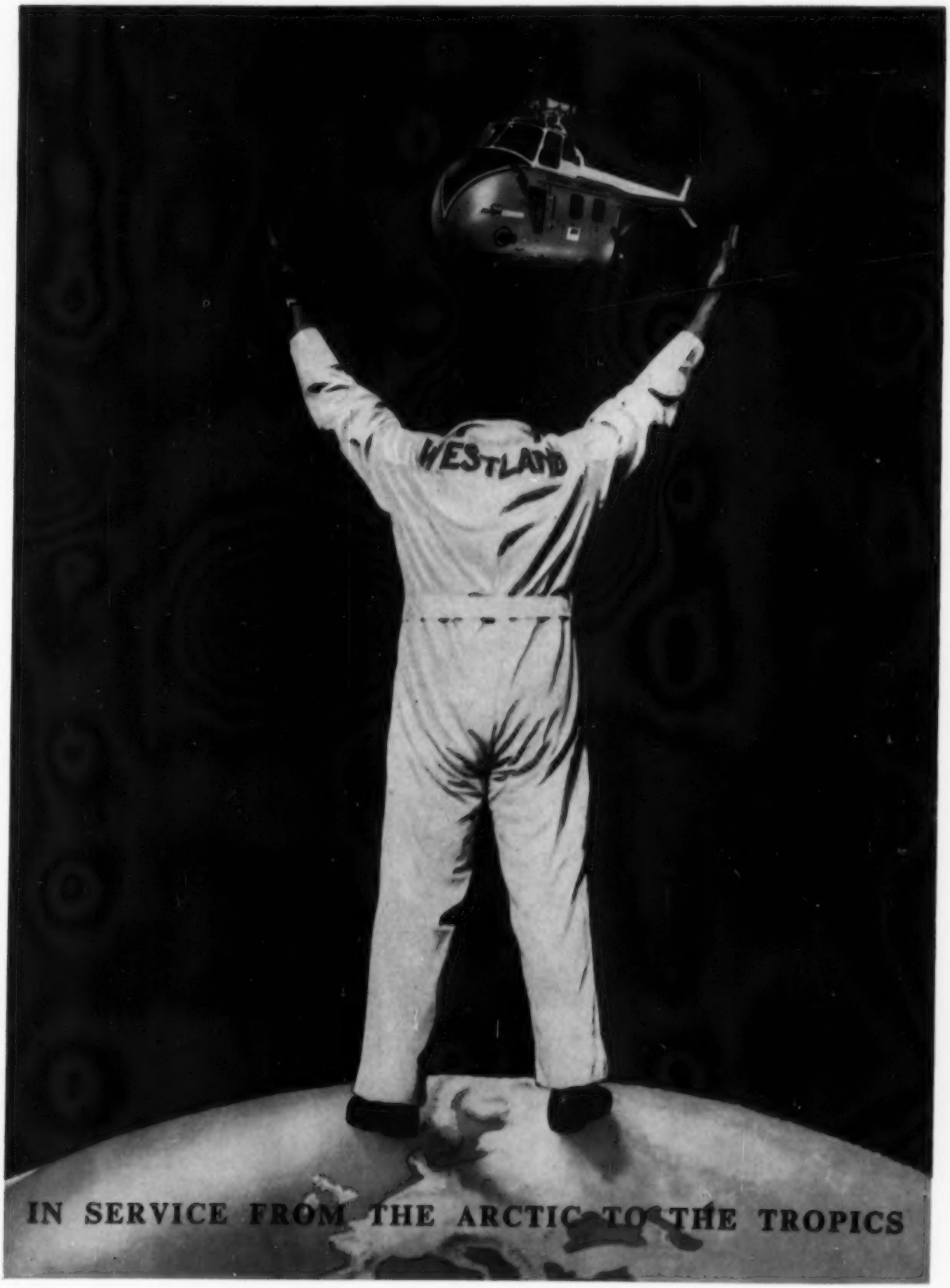
NEARLY 1,000 competitors are expected to take part in the British National Model Flying Championships to be held at Royal Air Force Station Waterbeach, near Cambridge, on Whit-Sunday and Monday. The organizers are the Society of Model Aeronautical Engineers. Admission is by programme, price 6d, at the gate; car parking is 2s 6d. Flying will take place from 11 a.m. to 6 p.m. on the Sunday and from 10 a.m. to 5 p.m. on the Monday.

### Helicopter Essay Competition

THE Helicopter Association of Great Britain has issued details of the 1955 Cierva Memorial Prize essay competition, in which a prize of £50 will be awarded to the competitor submitting the best paper on any subject connected with rotating-wing aircraft. The closing date is December 31st and rules and entry forms may be obtained on application to the hon. secretary of the Association at 4, The Sanctuary, London, S.W.1.

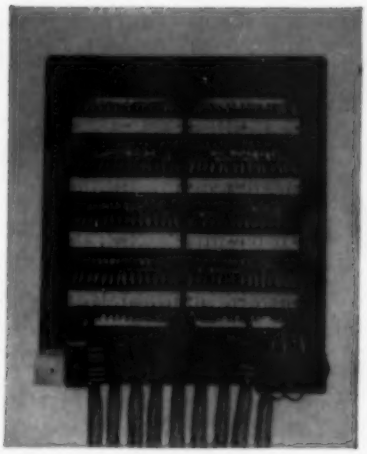
### Outback Met. Station

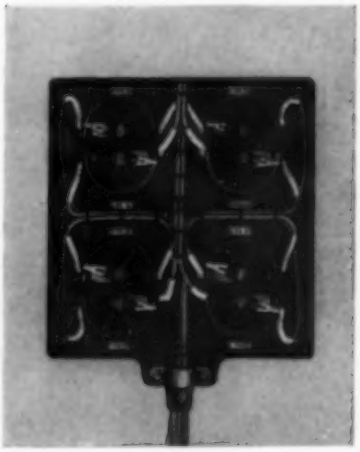
IT was recently announced by Mr. Athol Townley, Australian Air Minister, that the R.A.A.F. and U.S.A.F. will jointly operate a weather research station which will be built near Alice Springs in Central Australia. Mr. Townley stated that the U.S.A.F. would assign two officers and twelve men to the project and that equipment would very shortly arrive at Alice Springs in a Douglas C-124 Globemaster.

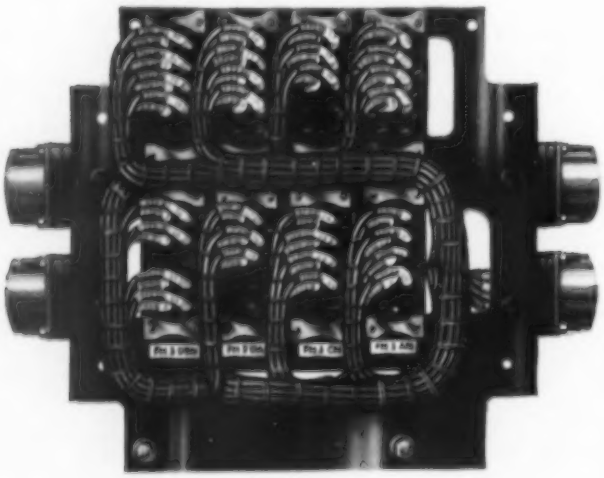

WESTLAND
IN SERVICE FROM THE ARCTIC TO THE TROPICS

# BOXING CLEVER!

Every item of equipment aboard a modern aircraft relies, either wholly or in part, upon the quality of an electrical circuit. And considering the growing complexity of electrical installation — the invariable result of scientific advancement — it is easy to see that the orderly housing and control of wiring systems gives rise to many problems of an extremely specialised nature. Like most of Britain's aircraft, the Britannia relies on Plessey to provide this wiring so ordered and located that regular servicing is a manageable function and that complete reliability is beyond question. For this air liner — the most advanced in the world — Plessey have contributed many specially designed features, together with standard wiring accessories of all kinds.







Plessey possess advanced facilities for design, manufacture and testing of preformed wiring systems from one connector to a complete system, for aircraft of all types and sizes.

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A53

# THE PARTY LINE ON AIRLINES

*Tories, Labour and Liberals Express their Views for "Flight"*

## CONSERVATIVE VIEWPOINT

**(Put by J. D. Profumo, O.B.E.)**

AIR transport gives Britain new highways. Experience has shown that a blend of public and private enterprise is best for this service. Close co-operation with shipping can often be of great value. The airways Corporations, as stated in the Conservative Election Manifesto, will continue to have an important rôle; we shall ensure that their relationships with independent operators are developed in the interests of traveller, trader and taxpayer.

The steps taken to give greater opportunities to private enterprise have not been allowed to impair the competitive strength of Britain's international services or undermine the international networks of B.O.A.C. and B.E.A.

Since 1951-52, B.O.A.C., which made a profit of over £1 million in 1953-54, has received no Exchequer grant. B.E.A. losses, incurred despite the introduction of new aircraft, are partly due to indiscriminate introduction of tourist fares, for which the International Air Transport Association, and not B.E.A., is responsible.

**IN less than a week, the General Election takes place. Though "Flight" is not concerned with politics in the popular sense of the term, the effect on aviation of political attitudes and actions is very much our concern. We accordingly invited the three principal parties to make "brief policy statements", which are printed here at unaltered length.**

The Socialist Government showed bias against the independent operators. That the latter managed to survive the period of Socialist administration was largely due to such windfalls as refugee evacuation in India and Pakistan in 1947; the Berlin Airlift in 1948; and additional trooping contracts due to various overseas emergencies.

Since 1948, independent companies have been allowed, as associates of one of the Corporations, to operate a number of internal services in the United Kingdom, short-haul services across the English Channel and other international services. The Socialists limited these associate agreements to a maximum term of two years. In September 1950, the Socialist Government did extend the maximum period of the validity of associate agreements to five years. The normal period has become seven years, under the Conservative Government, with a possibility of extension to ten years.

The Conservative Government has consistently held that non-scheduled air charter services are mainly the domain of the independents. The Corporations have not been precluded from charter work, but have not maintained special aircraft for this purpose.

As a result of Conservative policy, the independent operators are now permitted to play a fuller part, together with the Corporation, in all new civil aviation developments. The independents can now apply on equal terms with the Corporation for various services, including new overseas routes outside the Corporations' established networks; internal services which do not materially divert traffic from B.E.A.; "Colonial coach"-class services to any point in the United Kingdom dependencies, provided, among other things, that the services generate a new class of traffic; seasonal inclusive tours; and all-freight services which would not undermine the Corporations' existing services or those operated by associated independents. (Full details are to be found in *Hansard*, House of Lords, December 5th, 1951; and a statement by Mr. Alan Lennox-Boyd, *Hansard*, May 27th, 1952.)

Although the Corporation still fly about 96 per cent of the total scheduled services undertaken by United Kingdom operators, the Socialists have frequently alleged that the Conservative Government is out to help the private operators by depriving the nationalized Corporation of legitimate traffic. In fact, the aim of the Conservative Government has been to redress the balance in civil air transport which the Socialists weighted unfairly against the independents.

## LABOUR'S POLICY

IN the last few years Britain has taken the lead in the civil aviation field. New types of British aircraft have set the standard for the rest of the world.

A large part of the credit for this achievement must go to the publicly owned air Corporations, British Overseas Airways and British European Airways, which have been prepared to take the risks and incur the heavy development expenditures involved before radically new types of aircraft can be introduced into regular service. But now, just when the Corporations are reaping the gains from their enterprise, their prosperity is being undermined, and their ability to make further contributions to British aviation progress threatened, by Government policies designed primarily to benefit private aircraft operators.

The pattern for British civil air transport in the post-war years was set by the Labour Government's Civil Aviation Act of 1946, which established three Air Corporations (subsequently reduced to two by the amalgamation of British South American Airways with British Overseas Airways in 1949) having the exclusive right to operate scheduled air services within the United Kingdom, and to and from the United Kingdom. Provision was, however, made for private firms to operate scheduled services as "associates" of the Corporations where this would assist the latter in the efficient discharge of their functions. Charter work and air trooping were open to both the Corporations and private operators.

In its essentials the 1946 Act was a continuation of the policy of the "chosen instrument" adopted by successive Governments for over twenty-five years. The case for it was well stated by Sir Kingsley Wood, the Secretary of State for Air in the Tory Government of 1939, when introducing the second reading of the British Overseas Airways Bill. He said that it would provide "greater possibilities of progress and—particularly what I think is so much needed—the development of a far-sighted long-range policy in British aircraft production. I am satisfied that this cannot be attained in the face of the heavily subsidized competition of today by private companies, which must quite properly have regard to the primary interests of the shareholders who own such companies. I submit that under the new Corporation national interests and national advance come first."

Unlike Sir Kingsley Wood, the present Government has put the interests of shareholders in private companies before those of the nation. The changes in policy that it introduced in 1952 have removed the protection given to the publicly owned air Corporations in the expansion of their scheduled services, and discriminated against the Corporations in the freight and charter fields.

Since 1952, the promotion of the private companies' interests at the expense of the Corporations has proceeded apace. They have been given preferential treatment in the establishment of "all-freight" services and have been permitted to establish "Colonial coach" services. In theory the latter "generate a new class of passenger traffic without material diversion of traffic from the normal scheduled services of any previously approved U.K. operator." In practice they have materially diverted traffic from the Corporation's scheduled services; and when the latter proposed to meet the competition by offering a cheaper service the Minister would not permit them to do this. Insult is added to injury by the Minister's demand that the Corporations shall sign "associate" agreements with firms which are granted licences to operate Colonial coach or other regular services over particular routes. The legality of this requirement is doubtful, for it clearly contravenes the intention of the Air Corporations Act, 1949, which defines an "associate" agreement as "an arrangement calculated to further the efficient discharge of the functions of the Corporation."

Discrimination against the Corporations is carried even further by the Government's refusal to accept tenders from the Corporations for long-term air-trooping contracts. If the Corporations tender, and their tender is the lowest, it will not be accepted. The contract will be given to a private charter operator to bolster up private operation. Thus the Corporations lose valuable revenue and the public pay for the protection of private firms. Even with this favoured treatment, the private operators cannot provide modern aircraft for the work and the Conservative Government has indicated that it will buy aircraft with public money for hire to private operators so that they can continue to enjoy the benefits of this remunerative employment.

Because of the Government's refusal to grant long-term trooping contracts to the Corporations the problems arising from the replacement of aircraft employed on scheduled services by newer types have been aggravated. B.O.A.C. has been forced to dispose of Hermes aircraft withdrawn from scheduled services, at a loss of over £2 million.

One of the arguments advanced by the Minister in support of Government discrimination against the Airways Corporations is that the Corporations are unable to compete effectively with the independent operators for air trooping work. If this is the case the need to prevent them tendering in competition with private firms is not clear. However, the question of comparative

## THE PARTY LINE ON AIRLINES . . .

efficiency is also relevant to the consideration of the desirability or otherwise of the encouragement of private operators which generally characterises the present Government's policy. An examination of the evidence that is available is therefore worthwhile.

In the latest year for which figures are available the load factor achieved by the private operators was less than those achieved by B.E.A. and B.O.A.C.—59.3 per cent compared with 64.7 per cent and 64.4 per cent respectively—although the private operators' figure is inflated by the high proportion of trooping work that they do and the fact that they select their routes for other services and generally restrict them to the summer months The Corporations, on the other hand, operate throughout the year and, in the case of B.E.A. in particular, operate a number of unremunerative services which are socially desirable (e.g., services to the Western Isles).

Over the last seven years the Airways Corporations have carried out a substantial expansion of their services and have achieved increasingly favourable financial results; productivity per employee has shown a spectacular increase. Thus, between 1947-48 and 1953-54, B.O.A.C. more than doubled the volume of its services and turned an operating deficit of over £7 million into an operating surplus of £2 million. Output per aircraft hour was nearly trebled and output per employee more than trebled. Over the same period B.E.A. quadrupled the volume of its services and reduced its operating deficit from £3.3 million to £1.2 million. Output per aircraft was nearly trebled and output per employee was trebled.

If the circumstances (e.g., with regard to the introduction of new aircraft types) under which these results were achieved are taken into account, it is clear that they provide a favourable testimony to the efficiency and enterprise of the air Corporations and a strong condemnation of the Government's action in hampering their development. Civil aviation is a field in which considerable economies accrue to the large operator, and there is no reason to think that smaller private concerns could provide a more efficient service than the air Corporations can offer, particularly on overseas services. Further improvements in the Corporations' operating results could probably be obtained from the expansion of overseas services at decreasing cost but the Government's policy must, by limiting the scope for expansion, inevitably limit them.

Further factors to be considered are the quality of service offered and the obligations assumed by aircraft operators. The Corporations have aircraft and maintenance and other facilities overseas superior to those possessed by any private operator. Indeed, private firms engaged on trooping work rely on maintenance and other facilities provided by the Corporations on the routes along which they fly.

The Corporations have played a notable part in the development of new British aircraft at a considerable cost to themselves. They, particularly B.E.A., have provided services whose operation is uneconomic but desirable on social or other grounds. Both of these functions are valuable to the nation and it is desirable that the Corporations should continue to perform them, but their ability to do so may be seriously impaired if they are subject to political restrictions and if private firms are allowed to skim the cream.

If a Labour Government is returned to power at the General Election it will restore the position as it existed prior to the Minister's directive to the Air Transport Advisory Council of July 31st, 1952.

"Associate" agreements will be approved only if the services concerned do not compete with existing services of the Corporations and do not hamper the planned development of the Corporations' services. A similar condition will apply to all freight services. Existing services will be reviewed in the light of this requirement.

The Corporations will be permitted to maintain aircraft for charter work and to tender for long-term trooping contracts.

The continued progress of the air Corporations is closely linked to that of the British aircraft industry. If the Corporations are to hold their own in international competition they must have aircraft at least equal to those of their competitors. It is up to the British aircraft industry to provide them. So far as design is concerned, there can be little cause for complaint, but the production record of some British aircraft companies is disappointing. The nation cannot afford this and, as was stated in *Challenge to Britain*, the next Labour Government will take powers to acquire any firm which falls down on its job.

## LIBERAL BELIEFS

LIBERALS want to see British civil air transport play a leading part in world air transport. Believing that more competition is desirable, they would free the managements of the nationalized Corporations from all but general control, and would then pass legislation to enable others to meet the needs of the public. Private enterprise would be encouraged, particularly in internal aviation and in charter flying, both in competition with the national Corporations and over routes which cannot be served by the scheduled services.

Since the future both of our transport industry and of our reserve of trained personnel for defence depends largely upon the private flying movement, Liberals believe that Reserve flying schools should be reopened and that restrictions which hamper flying clubs should be reviewed.

In accordance with Liberal principles we would encourage private enterprise, with substantial help from the State, in development work of all sorts and by providing the results of scientific research in State institutions, to retain world leadership in aircraft design and construction.

The development of civil aviation would be aided by the Liberal policy of greater freedom to operate. In particular, we would oppose the unnecessary expenditure of dollars for the purchase of foreign aircraft which cannot be proved to be both operationally and financially more attractive than our own.

We also believe that Great Britain's lead in the field of flying-boats is something which should be maintained, particularly for very large units, and that we as a great seafaring nation should stand for the application to flying-boats of the same freedoms as apply to ships.

Finally, safety in civil aviation is more important than cost and in no circumstances should any misguided economy be allowed to affect safety. A highly efficient department, assisting and not hampering a virile air transport industry must see that every reasonable measure is taken to ensure that accidents do not happen.

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## FIAT'S LIGHT FIGHTER

ALTHOUGH it is officially confirmed that the Fiat G.91 light fighter/attack aircraft has proved successful in the NATO competition for aircraft of its class, it is by no means certain that the first of the three prototypes has flown, as has been reported. When the machine does take the air it is likely to be powered with a Rolls-Royce Nene, though the production model (negotiations are in progress for an initial batch of 27) will have the Bristol Orpheus.

## GUINEA-PIG DRONES

THE U.S. Atomic Energy Commission has released some details of the use of three Lockheed QF-80 radio-controlled target drones as data-collectors during the blast-before-last, i.e., the explosion of an atomic device at the Nevada test site on April 15th.

The three pilotless aircraft, fitted with Sperry electronic guidance systems, took off from Indian Springs A.F.B., under the control of a ground director alongside the runway. In attendance on each, and ready to take over when the drone was airborne, were two DT-33 director aircraft and two "chase planes," a TF-86 and a Navy TF33D Skyknight.

When the three formations reached the test area, control was handed over to three ground radar stations, the manned aircraft retiring to holding points several miles away. The planned operation was for the surviving drones—if any—to be picked up again by the director aircraft and shepherded back to their base. It was the duty of the "chase planes" to come alongside the drones and photograph any damage or other effects.

In the event, Col. H. E. Parsons, Deputy for Military Operations of the Test Organization, was able to report that the plan was "successfully executed in every respect."

One QF-80 was lost on take-off but was replaced immediately by a stand-by. It was planned that two of the drones would be lost, parachuting the effects data they had collected to the ground for helicopter recovery. All three aircraft survived the immediate blast effects, but two of them were seriously damaged. One was crash-landed on a dry lake bed near Indian Springs A.F.B. by its director aircraft, while the other was lost in the mountains to the east of Indian Springs. The third was landed intact at Indian Springs.

## SABRE 2, No. 19102

A LITTLE more than four years ago the first production Canadair Sabre, a Mk 2, serial-numbered 19102, was flown from its birthplace at Cartierville by an R.C.A.F. pilot. Just recently it returned on a farewell visit, bearing, in place of its original roundels, the dark-blue and white markings of the Royal Hellenic Air Force. The pilot, F/L. C. R. Simmons, who was to fly the machine to Europe, had not brought it to Cartierville from St. Hubert solely to allow employees to take a last look at their handiwork. He wished to say au revoir to his brother, F/L. D. B. Simmons, an R.C.A.F. acceptance pilot stationed at Canadair.

# AIRCRAFT INTELLIGENCE

***The basic trainer on the right is a North American T-28B, powered with a Wright R-1820 Cyclone and having a top speed of over 280 m.p.h. The fighter below it is an F-86H Sabre, apparently with four 20 mm guns in place of the former 6 × 0.5in armament.***

## Great Britain

*Civil Registrations.* Among recent additions to the register of British civil aircraft is G-AOBG—the Somers-Kendall SK.1 single-seat jet racer; its owners are given as Somers-Kendall Aircraft, Ltd. Others include G-ANYK, a D.H.90A Dragonfly acquired by B.E.A. and formerly registered F-OAMS; G-ANYB, a C-54B Skymaster bought from the United States by Air Charter, Ltd.; and G-ANCA, the first Bristol Britannia 300. The latter aircraft, now well advanced in construction, was to have been G-AMYL, but this registration, together with G-AMYK (the letters allocated for the Britannia 200), has now been cancelled. Formerly operated by West African Airways Corporation, Marathon 1As VR-NAS and VR-NAT now appear in the British register as G-AMHS and G-AMHV. The owner is given as the Minister of Supply; the aircraft have, in fact, been acquired for transport and communications flights between various M.o.S. establishments.

## U.S.A.

*Boeing B-47.* According to *Aviation Week*, the present fly-away cost to the United States Air Force of a Boeing B-47 Stratojet bomber is $2,225,000.

*Lockheed XF-104.* The destruction, a few weeks ago, of one of the two Lockheed XF-104 supersonic air-superiority-fighter prototypes while on an armament test flight over the Mojave desert was caused by "an armament explosion." Lockheeds give the assurance that there was no difficulty with aerodynamics, structure or powerplant.

*Beechcraft and the Paris.* As already recorded, Beechcraft have taken an option for production under licence of the Morane M.S.760 Paris, and are paying the expenses for shipping the prototype to America and demonstration there. The U.S. Navy has also asked for demonstrations and has shown interest in the aircraft for training and communications. In these roles the Paris would be a direct competitor of the Cessna XT-37, a two-seater which strongly resembles it.

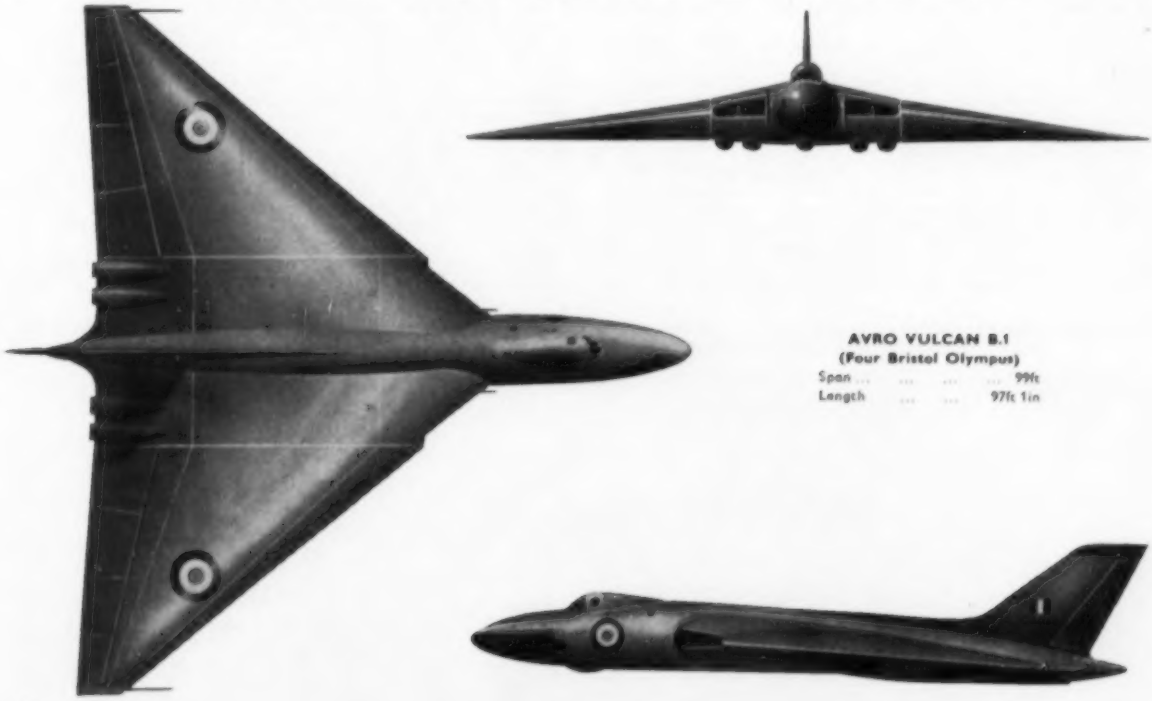
## France

*S.O.9000 Trident* That this fighter-research prototype, with Armstrong Siddeley Vipers at its wing tips in place of the original Turbomécas, and with an SEPR liquid-fuel rocket in the rear of the fuselage, has achieved supersonic speed both in level flight and on the climb is already known. The sequence of its early testing, at the beginning of March, was that after exceeding Mach 1 "by a large margin" in a shallow dive without switching on the rocket, tests were initiated under rocket power. Three days later the machine greatly exceeded the speed of sound during the last stage of a climb, using only a fraction of the available rocket power. Tests are now being conducted by the S.N.C.A.S.O. test pilot Goujon with a view to obtaining much higher performances. The Trident will be a star exhibit at the 21st International Salon de l'Aeronautique, which opens on June 10th.

*Marcel Dassault Mystère IV.* Another impressive item scheduled for the Salon—on June 18th and 19th—is formation flying by twelve Mystère IVs from the Mont-de-Marsan base, during the course of which all aircraft will simultaneously "break the sound barrier."

*S.E. Alouette II.* Three examples of this Turboméca-powered helicopter, tests of which are now under way at Buc, are on order for the French Navy. Unofficial performance figures show that the machine has a considerable reserve of power at a gross weight of 2,870 lb, and the results obtained exceed the French Naval specifications. Cruising speed is in the order of 110 m.p.h.

*Potez 75.* A pilot officially appointed by the Venezuelan Government, M. Oswald Gibelli, has made several flights in this twin-boom pusher ground-attack prototype, as a result of which he has stated that the machine "corresponds to the requirements of his country."



**AVRO VULCAN B.1**
**(Four Bristol Olympus)**

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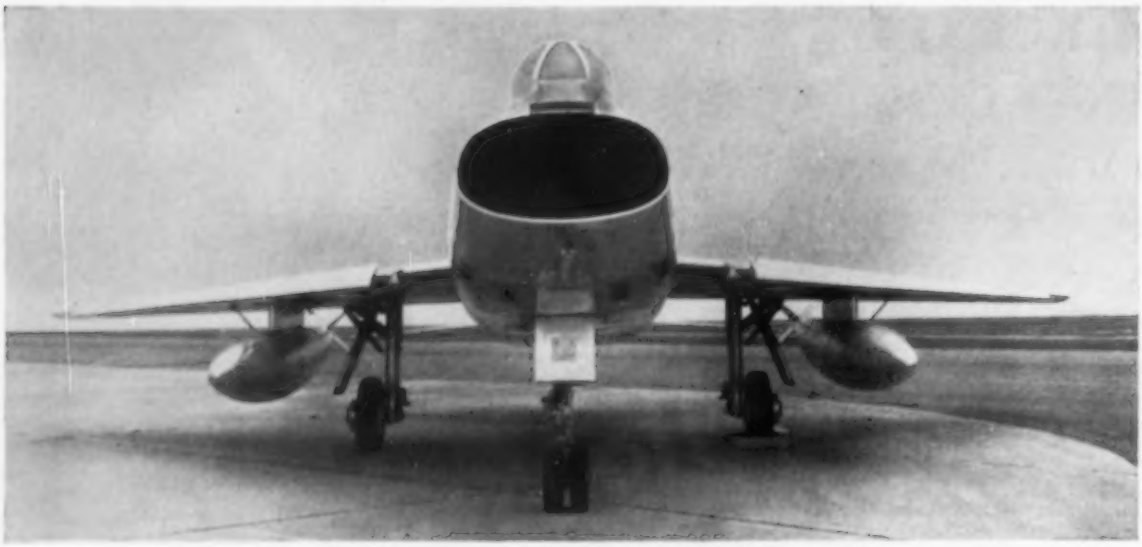
|---|---|
| Span ... ... ... ... | 99ft |
| Length ... ... ... | 97ft 1in |



# SUPERSONIC FIGHTER

## *A Critical Examination of the F-100A Super Sabre*

CONTRARY to the official procedure in this country, American manufacturers are permitted unrestricted publication of photographs of new types of military aircraft, either complete or under construction, so long as no "classified" items of equipment are revealed. As a result we now have more detailed photographs of the North American F-100 than we have of any contemporary British machine; and so much can be gleaned from these photographs that it has been possible for a *Flight* artist to prepare a cut-away drawing of this aircraft. This illustration incorporates only what can be established without recourse to guesswork; nevertheless, it reveals a great deal and appears on pages 682-3.

The F-100 is, by any standard, a remarkable machine, and it is worthy of as much study as its security status allows. We have, therefore, prepared a concise survey of the major features exhibited by the machine as it now exists, together with notes on its possibilities for future development.

The basic design was a private venture by North American Aviation, Inc., stemming from initial projects of about 1949. The early development took place outside the U.S. Air Force weapons system concept of purchasing (in fact, the basic design preceded this concept), but the Air Force were quick to buy the design when it became apparent that it would be a great advance on anything that had gone before.

All through the early life of the design, the dominant North American machine was the F-86 Sabre. It is, therefore, not surprising that the company tried, wherever possible, to adhere to proven features of the F-86, and to use the earlier machine as a basis. Superficially, the two designs appear utterly dissimilar but, in fact, their similarity in some regions is quite remarkable. This emphasizes how correct was the concept of the F-86, particularly when it is remembered that the prototype F-86 flew in October 1947 (the F-86E was fully described in our issue of January 30th, 1953, and later variants were described on January 15th, 1954).

The initial concept of the F-100 visualized a true supersonic fighter, i.e., a machine which could reach, and sustain, supersonic speed in level flight. Such an aircraft had, of necessity, to be a very different machine from the F-86, and its design posed very severe problems. These problems covered the whole range of design criteria, but particular emphasis was placed on stability and control, the breathing characteristics of the power installation, the operating conditions of the systems and military equipment and the overall performance of the aircraft from a practical "mission" viewpoint.

Even the design of the structure required the fullest possible use of the latest available data, and implied the adoption of advanced techniques, in many cases considerably ahead of anything possible (either then or now) in this country. A number of basic layouts were considered, but opinion crystallized upon a remarkably conventional (and Sabre-like) design. In fact, once the North American designers had established that the Sabre geometry could be employed in a supersonic fighter it is doubtful if they ever looked back. This, in spite of a fundamental stability problem (described in our issue of February 25th, 1955, p. 251) which became manifest last autumn.

The wing adopted has a leading-edge sweep of 45 deg, a figure which resulted in the design being known initially as the "Sabre 45." From the aerodynamic aspect, the wing is quite conventional, having a simple geometry and a low aspect ratio (in spite of the long-range requirement) to achieve a good rate of roll, as large an area as possible and a low thickness/chord ratio (of about 7 per cent).

After examining the various possibilities, the North American engineers decided to adopt an unusual form of lateral control

***At the head of the page and below are views which show to particular advantage characteristic features of the F-100, especially the design of the intake, fuselage, undercarriage and wing slats, and the arrangement of the auxiliary tanks.***

# ROLLS-ROYCE

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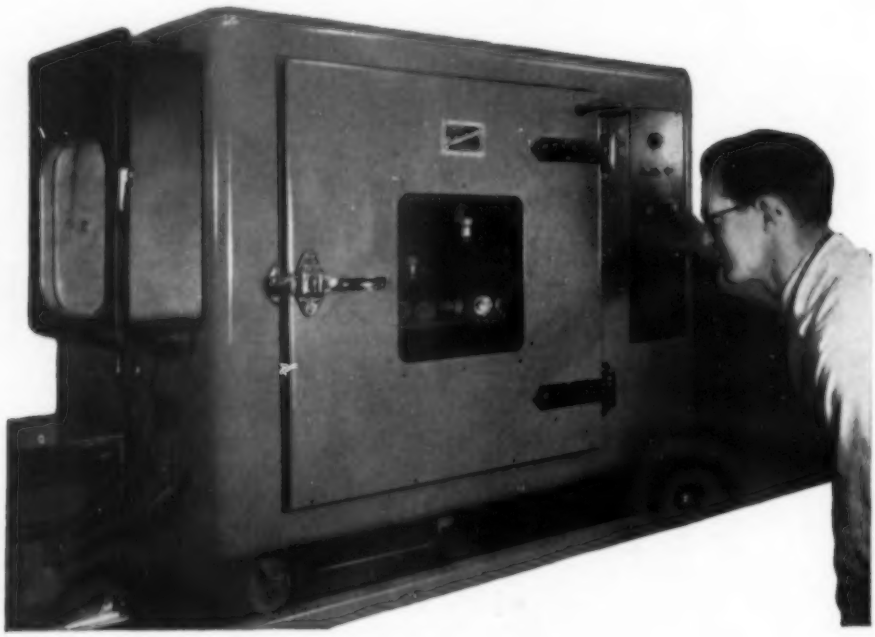

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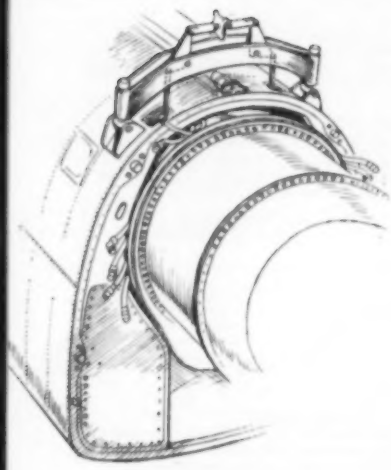
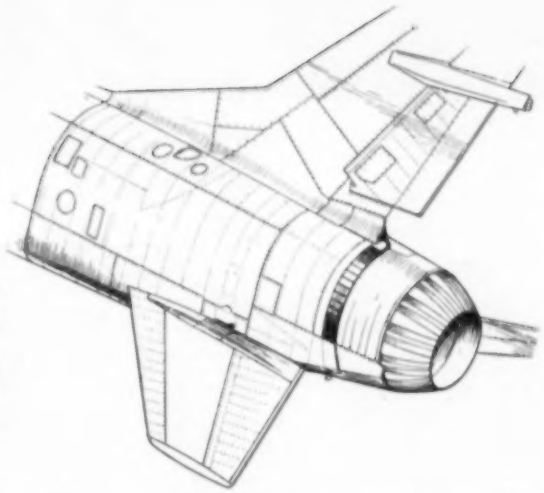


*(Left) With the tail section, and therefore the rear engine support, removed, the engine is supported at the fuselage break by an external rig. The end of one fuel tank is also visible here—in the bottom-left section of the end-frame.*



*(Right) The braking parachute is stowed in a compartment under the tail. On release, the cable strips around the fuselage port side, from beneath the flaps seen aft of the tailplane, and streams from a pick-up beneath the rudder. The ribbon canopy was illustrated last week (p. 661).*

## SUPERSONIC FIGHTER . . .

(i.e., in the rolling plane). The ailerons were mounted well inboard, over the greater part of the trailing edge, in the position normally occupied by the flaps. It was found that, with the type of wing chosen, not enough flap could be fitted to justify such surfaces. This is undoubtedly a factor which will become marked on all highly swept machines, a British example being the Gnat; on such machines the length of trailing edge available is very limited, and the size of flap possible is not enough to produce a worthwhile gain in lift or change in attitude. On the other hand, the inboard ailerons minimize the wing twisting moment, which can be excessive on a very swept wing with conventional ailerons.

Having no flaps, and owing to the considerable sweep angle and high-speed profile of the wing, it was decided to fit full-span automatic leading-edge slats. These should not be confused with leading-edge flaps or with a drooping leading-edge; the F-100 has true Handley Page slats, and their incorporation has resulted in a notable increase in available lift, a decrease in manœuvring drag and better stability at high lifts. The F-100 can fly at an apparently impossible angle of attack—again a feature characteristic of highly swept wings—at a speed not unduly greater than that for the F-86. Actually, the F-100 wing loading is lower than that of some recent F-86 models. On the other hand, the wing loading is still sufficiently high to take the edge off the performance at top altitude; British fighters are generally less weighty than their American counterparts, and as a result perform better at over 40,000ft.

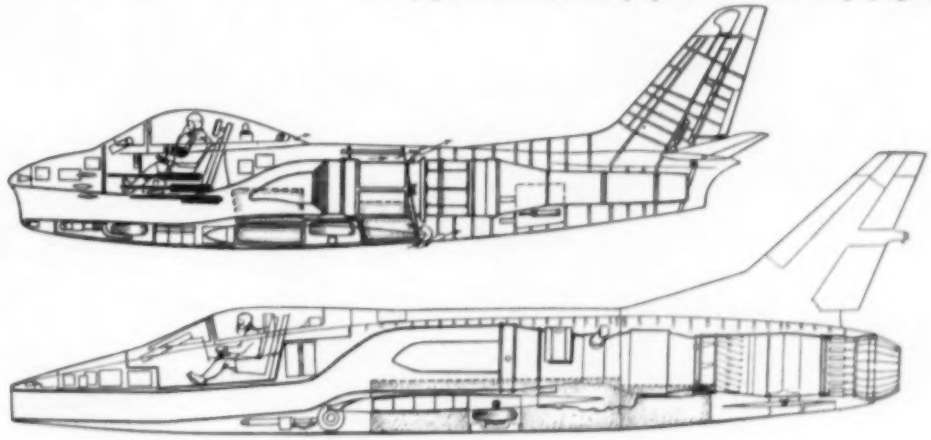
The structure of the F-100 wing is such as to permit relatively easy and rapid manufacture by a factory equipped with very large and capable tools. Major loads are taken by two root-to-tip spars which, with an immensely thick, screwed-on taper skin, form a massive box between about 20 and 60 per cent chord. Between these spars lie four other full-depth spanwise members, with sheet webs braced by vertical stiffeners. These four subsidiary spars cease about two-thirds of the way to the tip, and the outer wing is of comparatively light construction. The skin, however, is continuous to the tip, the outer part being flush-riveted. The leading and trailing portions of the wing are much lighter in construction, and the front upper edge of the forward (main) spar has a full-span piano hinge, identical with that of the F-86, upon which is hung the leading-edge structure, which hinges for access to the interior systems.

The ailerons are each made in two parts, and they are fully powered by irreversible jacks bolted to the rear face of the rear spar. Control linkages run down the leading edge to a point opposite the jacks. There are no tabs anywhere on the aircraft. The slats run out on massive forged cantilevers which are located between pairs of rollers. These forged supports do not, however, retract into perforations in the spar web, as they do on the F-86. Slat incidence is controlled by a tubular strut attached to the inside of the slat leading edge at each main attachment point. There are five slat sections on each wing, one more than on the F-86.

At the root there is a heavy chordwise forging of I-section extending from the rear spar to well forward of the front spar. This root member is kinked, and projects into the fuselage at its rear end. Main spar loads are carried across the fuselage by a carry-through member; there is also a large cut-out in the underside of the fuselage which accommodates the rear spar carry-through member, a less-swept beam mounted farther aft and, between the two, the wheels of the retracted undercarriage.

The fuselage is readily divided into two portions, at a "break-point" just behind the wing. By removing the rear section, unrestricted access is provided to the whole powerplant up to, and including, the combustion chamber. During erection, the engine is mounted in the main fuselage, with some 15ft of engine and afterburning jet-pipe hanging cantilevered from the break-point bulkhead. The whole assembly is then lifted from a roof crane and lowered on to the wing, the rear fuselage and tail being added later. When the rear fuselage is attached (by means of four self-aligning connections) it carries the rear end of the afterburner, so that the latter is not cantilevered in flight. During ground running, with the tail off, the engine is supported by a special truss which clamps on top of the fuselage and prevents the engine from whipping about (see detail sketch).

The ducting is remarkable. North American chose a nose inlet for several reasons, chief of which they describe as "minimum complication plus excellent recovery under anticipated flight conditions; not subject to problems associated with side inlets; and desirable from standpoint of location of equipment, engine, etc." Certainly a nose inlet is best during flight at varying angles of attack or when yaw might be present; again, it is the best supersonic intake. On the other hand, the duct length is necessarily very great and losses are proportional to duct length; again,



*Drawn to the same scale, these side views immediately disclose the differences in size and shape between the F-100 and its forebear, the F-86E Sabre.*

# SUPERSONIC FIGHTER...

1 Radar antenna.
2 Radar and radio equipment.
3 Cooling air bleed-off from main duct.
4 Cooling air outlet.
5 Main engine air duct.
6 Outer gun port.
7 Gun barrel support.
8 M-39 20 mm cannon (two each side).
9 Ammunition tanks and gun feeds.
10 Retracting automatic gun-sight cowl.
11 External canopy-operating buttons.
12 Oxygen cylinder. Access through same panel to power controls.
13 Cockpit pressurization control valve.
14 Suppressed aerials.
15 Air outlet.
16 Access to power controls.
17 Fuel fillers, 360, 221 and 310 U.S. gallons.
18 Refuelling earth point.
19 Fuel tank.
20 J57 turbojet giving 10,000 lb thrust dry.
21 Compressor air bleed.
22 Fuselage break point.
23 Fuselage break access panels.
24 Afterburner fuel spray nozzles.
25 Afterburner variable exhaust nozzle.
26 Afterburner variable nozzle operating jacks.
27 Rear engine support.
28 Braking parachute stowage.
29 Braking parachute cable pick-up point.
30 Fuel vent.
31 Rudder actuator access.
32 Aileron actuator.
33 Aileron control runs.
34 Inset aileron.
35 All-moving tail. (Heavy-gauge skin between spars, light structure nose and trailing edge sections; fin similar.)
36 Air brake.
37 Nosewheel steering motor.
38 Mainwheels, fitted with anti-skid brakes, retract into fuselage.
39 Undercarriage doors (normally closed with gear down).
40 Supersonic under-wing tanks (275 U.S. gallons).
41 Navigation and identification lights.
42 Leading-edge slats (in five sections each side; carried on straight outriggers, with secondary struts to determine angle when extended).
43 Thick skin over multi spars on inner half wing. Probably changing to stringers and increased number of ribs outboard.
44 Piano hinge nose section attachment.
45 Retracting bumper.
46 Pressure head boom (full length not shown).
47 Control and pipe runs through spine.
48 Pads and access panels with engine support rig when tail is removed.

reference to the drawing shows how much valuable space is occupied by ducting (approximately half the total volume of the fuselage). Present F-100s have a direct pitot intake; the efficiency of such an intake begins to fall off at about Mach 1.2 owing to the normal shock which it produces; for Mach numbers much above this, a central bullet is needed, to create oblique shocks and so postpone the fall-off in efficiency. No doubt later F-100s will have such a feature.

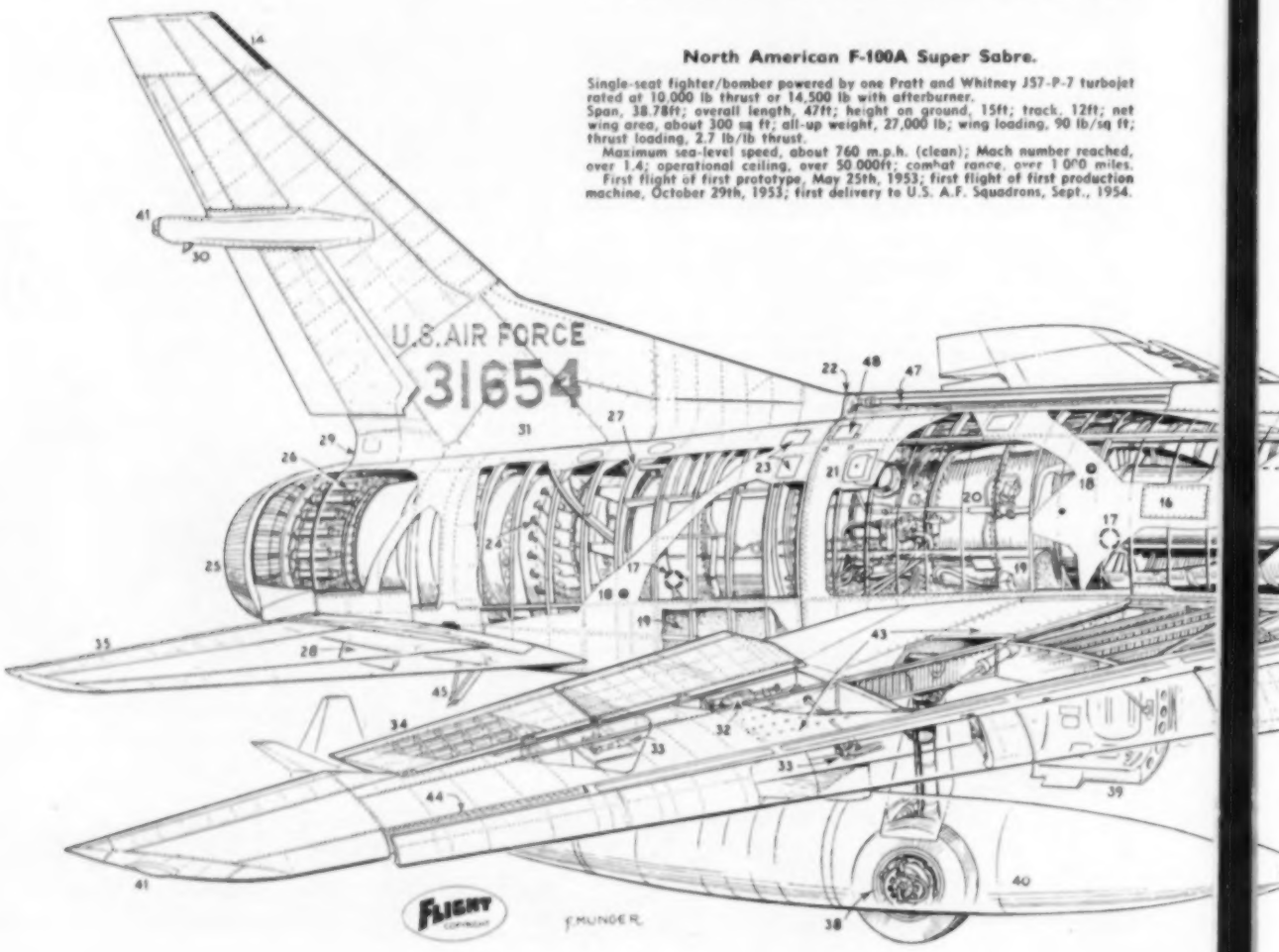
The intake is of a distinctive roughly oval cross-section, and the duct remains flattened right back to the leading edge of the wing. This early part of the duct passes under the radio and electronic bay, between the guns under the cockpit floor and through the cramped space left between the retracted nosewheels and the ammunition tanks. It then rapidly increases in cross section, and becomes circular, the upper wall rising almost to the roof of the fuselage and then running horizontally into the engine. Such a diffuser-like section must impose losses and may even cause break-away under some conditions. The ammunition tanks seem to be the limiting factor determining the diffuser angle.

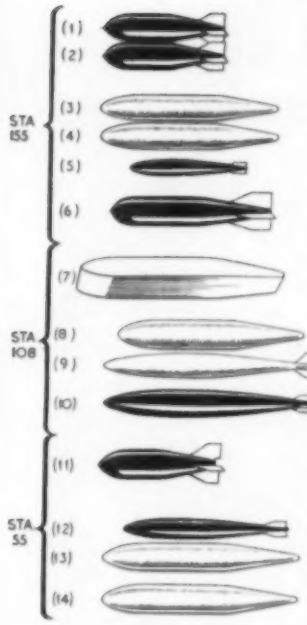
Fuel is contained in large tanks occupying the entire volume under the engine and centre fuselage, except for the bays devoted to wheel stowage and the wing carry-through structure. Fillers are arranged along the starboard side of the fuselage. The fuselage tanks are vented by pipes which run up the side of the fuselage to a longitudinal pipe contained beneath the dorsal "spine" fairing. The final overboard vent is situated just above the rudder, well clear of the engine and in relatively undisturbed air.

The engine itself is the Pratt and Whitney J57-P-7, split-compressor turbojet, weighing about 4,500 lb and giving 10,000 lb thrust (14,500 lb with afterburner). Owing to its high pressure ratio (about 12 : 1) this engine gives a very good gallons-per-mile figure and also performs well at altitude. On the other hand, it is very large (particularly with the long type of afterburner) and is over half-a-ton heavier than British engines of comparable power. A large nose bullet fairing is fitted to the J57, covering either a constant-speed alternator, a starter, or both. Normally the engine accessories and starter are mounted underneath in the

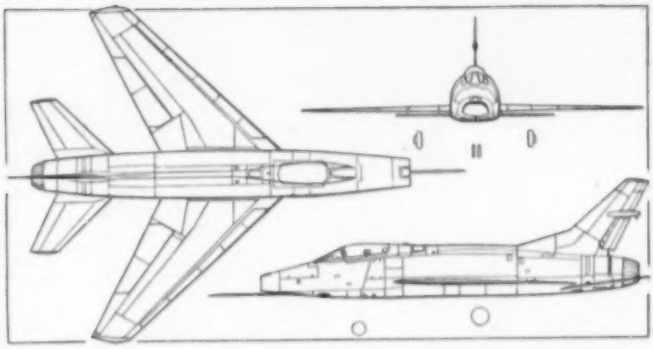
**North American F-100A Super Sabre.**

Single-seat fighter/bomber powered by one Pratt and Whitney J57-P-7 turbojet rated at 10,000 lb thrust or 14,500 lb with afterburner.
Span, 38.78ft; overall length, 47ft; height on ground, 15ft; track, 12ft; net wing area, about 300 sq ft; all-up weight, 27,000 lb; wing loading, 90 lb/sq ft; thrust loading, 2.7 lb/lb thrust.
Maximum sea-level speed, about 760 m.p.h. (clean); Mach number reached, over 1.4; operational ceiling, over 50 000ft; combat range, over 1 000 miles.
First flight of first prototype, May 25th, 1953; first flight of first production machine, October 29th, 1953; first delivery to U.S. A.F. Squadrons, Sept., 1954.






*A diagram, based on official information, of typical under-wing loads carried by the F-100A Super Sabre at wing-stations 155, 108 and 55: (1) and (2), 750 lb general - purpose bombs; (3) 750 lb napalm tank; (4) M.26 or M.28 chemical tank; (5) 500 lb "Ex 12"; (6) 2,000 lb general-purpose bomb; (7) pack containing forty-five 2.75in folding-fin rockets; (8) 750 lb napalm tank; (9) 275 U.S. gallon N.A.A. fuel tank; (10) 2,000 lb "Ex 11"; (11) 1,000 lb general - purpose bomb; (12) 1,000 lb "Ex 10"; (13) 750 lb napalm tank; (14) U.S.A.F. 200 U.S. gallon fuel tank.*



J57, but the F-100 is believed to have an air-turbine starter attached to the front of the low-pressure compressor. The afterburner is fed with fuel from numerous separate injectors, and the area of the propelling nozzle is varied by 24 hydraulic rams, which move longitudinally sliding "petals" riding in curved guides.

The undercarriage employs hydraulically retracting legs; and it is rather stalky, owing to the high angle of attack adopted by a slatted, swept wing at low airspeeds. A tail bumper is fitted. The main gear has outboard multi-disc brakes of Hytrol non-skid pattern, and the nose unit is steerable. Twin wheels were needed for the nose gear in order to meet the dynamic load ratings without increasing the diameter to a point which would project into the intake duct.

The tail is formed from massive two-spar surfaces swept at roughly the same angle as the wing. The large fin (recently increased in height to assist in overcoming the stability trouble previously referred to) has many chordwise ribs and is covered with stretch-formed skin with a sharp leading edge. The tip carries a radio aerial under a plastic moulding. Inside the fin is the jack assembly powering the relatively small rudder, the latter being hinged top and bottom with a considerable area forward of the hinge line. The tailplane is a single slab surface, also fully powered, and with at least 20-deg range of movement.

The underside of the fuselage is remarkably flat from nose to tail. Not only does this permit the greatest possible tankage but it eases junction problems with the tailplane, the root of the latter remaining hard up to the fuselage at all angles. Under the tailplane is a box housing the braking parachute. This box is opened by a pair of doors, and the canopy then drops out downwards; the attachment cable then, curiously, is pulled out from a channel around the port side of the rear fuselage (where it is faired by many small sprung flaps) and the pull is then finally taken to a socket at the base of the fin (see sketch on p. 681).

Most of the electronic equipment is housed in a large bay forward of the cockpit, where cooling is provided by a refrigeration circuit fed from the inside of the duct. North American have found that external accessory-air intakes are anathema on supersonic machines and, as a result, all auxiliary air supplies are fed from tappings off the engine duct. Individual airflows are, however, spilt overboard at various points on the fuselage surface. High-pressure air is taken from the engine for accessory-turbine shaft-power and for cockpit pressurization. The engine compressor also has a large blow-off starting valve connected directly to an overboard outlet on the starboard side.

The armament at present comprises four 20mm M-39 rapid-firing cannon (*Flight*, January 28th, 1955) in the lower part of the nose. The combined rate of fire exceeds 6,000 rounds per minute. Ammunition tanks resemble those of the F-86F, in that they slide in on horizontal rails. They are very large, and port and starboard tanks almost meet on the aircraft centre-line. The forward tanks

*A particularly striking aspect of the F-100, emphasizing the low mounting of the tailplane. The slot width is also apparent.*

## SUPERSONIC FIGHTER . . .

are slanted in order to provide for the longitudinal displacement between the two guns on each side. Link and case chutes are simple flush orifices. The engine intake is, of course, well forward of disturbances created by firing of the guns.

Each wing is provided with three pick-up points for external loads, at stations 55, 108, and 155. The accompanying sketch (p.683) shows the variety of stores which can be carried by each rack; the total load in the present F-100A is of the order of 6,000 lb. Where maximum range is required, two low-speed tanks can be secured to the racks at station 55 and two "unlimited" tanks can be attached at 108. The low-speed tanks are drained during take-off and climb to operating height, and are then dropped before working up to high Mach numbers. The unlimited tanks, which are of a curious form as shown by the main drawing and the photographs, can be kept on during supersonic flying. The special store (not shown) is a nuclear weapon, with a high-drag trajectory to permit the launching aircraft to get well clear before detonation (although it is probably streamlined until it is released). Only one such store need be carried at a time, and it would presumably be balanced by an equivalent load on the other wing. Nothing can be carried under the F-100 fuselage, owing to the continuous succession of doors and the large air brake.

The U.S.A.F. are becoming concerned at the relative ineffectiveness of day fighters; it is now generally agreed that interception radar is required for high-altitude work even on the clearest day. The F-100A has only a radar gunsight, fed from an aerial mounted beneath the upper lip of the intake. Later versions of the aircraft are to have full radar fire-control, and they should be capable of employment in all weather conditions. It is also possible that some forms of the aircraft may have fuselage-mounted folding-fin aircraft rocket missiles (Mighty Mice), although, in view of the fact that these weapons can be carried under the wings, it is probable that the guns will be retained.

Altogether, the F-100, of which some hundreds have now been built, is as much ahead of its contemporaries as was the F-86. It is, however, far from perfect, and North American would no doubt do things differently had they to design another supersonic fighter/bomber today. In the past two years much has been learned of the advantages which can be gained by reducing peak suctions over a supersonic body, this trend having already manifested itself in "Coke-bottle," or wasp-waisted, fuselages, in which the cross-section is reduced in line with the mid-chord of the wing. The Grumman F11F Tiger and the Convair F-102A both have such a waist and it is certain that, if it were a design feature of the F-100, supersonic drag would be very considerably reduced. Alternatively, the maximum Mach number could probably be raised well above the present limit of about 1.45.

It was recently stated that the F-100 was on the brink of "a new high in performance," and it is possible that these increases in Mach number will result from aerodynamic improvement rather than from increase in power. W.T.G.

# ROLLS-ROYCE ENGINE HISTORY

THE story of Rolls-Royce aero engine development was heard by some 250 gas engineers who attended the luncheon given at Kenilworth last week—in connection with the British Industries Fair—by the Gas Council. It was told in an address by Mr. A. F. Kelly, B.Sc., A.M.I.C.E., A.M.I.Mech.E., M.I.P.E., director and general manager (manufacturing) of the Rolls-Royce aero division. The Council's choice of Mr. Kelly as the speaker on this occasion was an appropriate one, for he himself received his early engineering training in the gas industry.

Though his historical review was necessarily a brief one, touching on little more than the highlights of the company's 40 years' work on aero engines, Mr. Kelly more than held the interest of his audience. The salient facts would be familiar to most *Flight* readers—we have quoted them in a number of articles during past years—so it is unnecessary to record them here. It is, however, interesting to be reminded of the scale of the Rolls-Royce war effort. In 1935-36 they employed just under 8,000 people; by the end of 1944 their payroll was 57,000, and they were also employing over 500 firms as sub-contractors. This was for Merlin engine work at Derby, Crewe and Glasgow, and did not include the production of these famous units by the Ford Motor Co. at Manchester and by Packard in America. By the end of the war over 150,000 Merlins had been built.

Having concluded his historical review, Mr. Kelly remarked upon the good service provided for his company by the gas industry. At present they were using, in their various factories (Derby, Glasgow, Crewe, Barnoldswick and Mountsorrel) nearly 600m cu ft of gas a year. The bulk of this consumption was for heat-treatment processes, foundry melting applications coming second; melting, however, constituted the biggest single load.

The gas was used in appliances of practically every type, ranging from Bunsen burners to the largest furnace and immersion-heating installations. One unusual piece of equipment recently installed was a gas-fired flash boiler, of American origin, for raising steam to drive a small high-speed turbine. Steam at the appropriate pressure was available literally within minutes of starting up, and the boiler could be shut down equally quickly. (We learn that the steam turbine referred to by Mr. Kelly is being used to drive jet-engine turbines in overspeeding tests.)

The speaker concluded his address with some parallels between turbojet engineering and comparable aspects of gas engineering. Thus, in the matter of flow measurement, some engines now under development showed a figure of the order of 10m cu ft of air an hour. This was recorded by a flared-entry meter with an accuracy of about 97 per cent.

The modern jet engine could, in some degree, be likened to a large gas burner, but the combustion space was relatively much more restricted than it would be in a gas burner designed to give the same amount of heat. The combustion area of present production engines was only 45 per cent of that of an equivalent gas burner, yet they also operated at an air/fuel ratio four times as great. This meant that in an engine of 10,000 lb thrust there was an airflow of 280 tons an hour, in which period 144m B.Th.U. were released.

## BACK TO ORANIENBURG

AFTER lying unoccupied for two years, the airfield at Oranienburg, in Germany's eastern zone, has begun life anew. Recently a squadron of Il-28 twin-jet bombers arrived there, accompanied by a Po-2 trainer and two Il-12 transport aircraft. One or two of the Il-28s were trainers, with a second cockpit raised above the first. All carried wing-tip tanks. Shortly afterwards a dozen or two German pupils of the *Vopo* (*Volkspolizei*) *Luftwaffe* arrived to undergo training. A number of formation flights have been made, and there is gunnery practice against a drogue towed by a trainer. Bombing training is also undertaken at Oranienburg.

At Cottbus, fighter pilots are being trained on Mig-15s, after basic training at Kamenz, in Saxonia. Although Russian pilots of these aircraft fly at great heights, German pupils are said to be restricted to a height-band of 500-1,500m and are not allowed to fly singly.

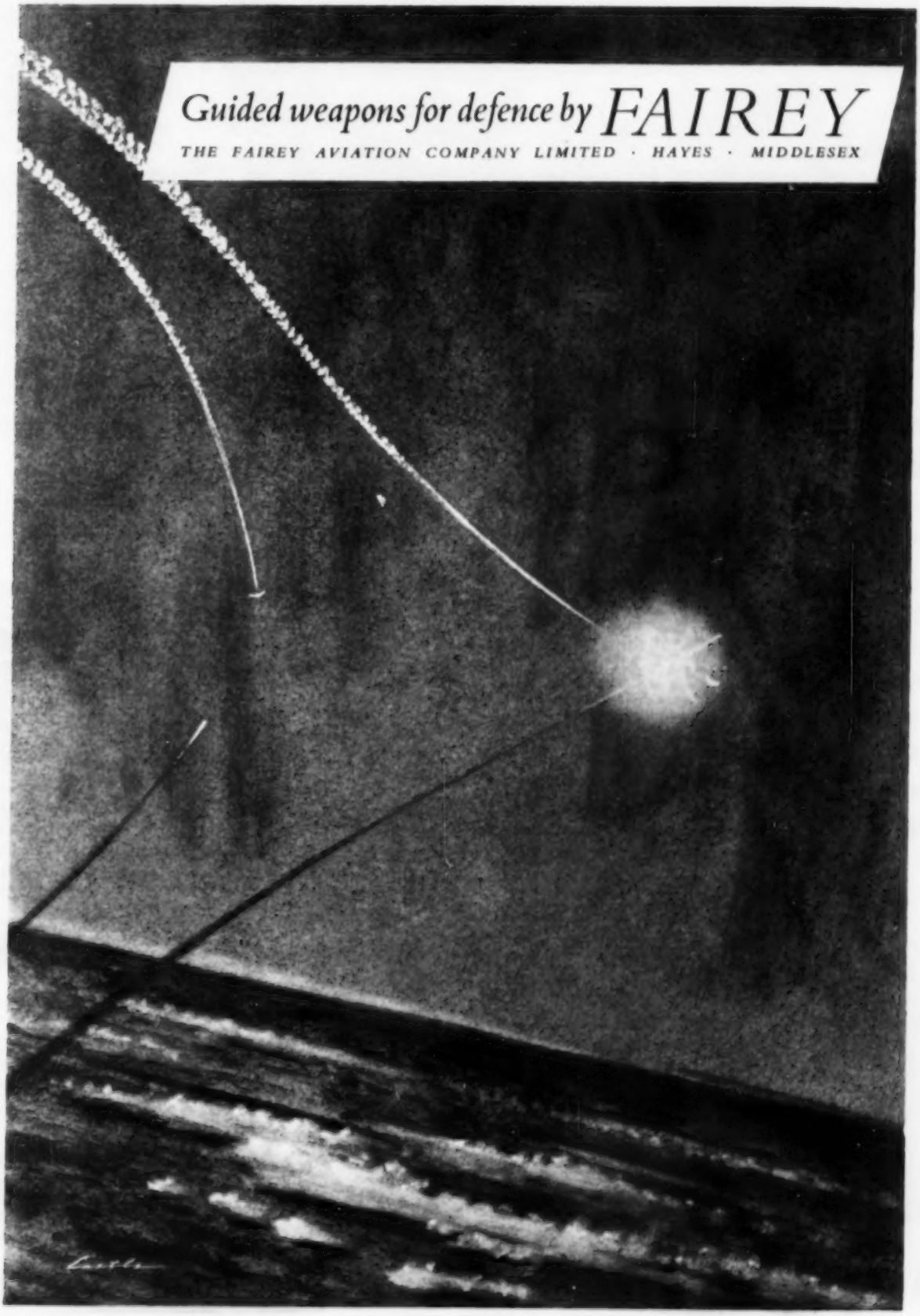
## PHOTOGRAPHIC TECHNIQUE

THE Institute of British Photographers National Exhibition of Professional Photography, open until June 7th at the R.B.A. Gallery, Suffolk Street, London, S.W.1, is quite up to its usual high standard and in its 860 exhibits has something to please or interest everyone.

For those with aeronautical interests there are a number of air-to-air shots of aircraft and some excellent aerial pictures by the photographers of Aerofilms, Hunting Aerosurveys and Stewart Bale, Ltd.

In a collection of very remarkable colour prints is one by Mr. Elphinstone, called *Power over the Atlantic*. Showing the port wing and engines of a Constellation lit by the yellow light of a setting sun, it conveys a wonderful sense of deep space.

Of other things that fly, there are five examples of bird photography by Walter E. Higham—each a gem—and some perfect colour pictures of various insects by the Shell Photographic Unit.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**Recent progress and present activities of American Airlines, pioneers in air-freight development, are discussed in this, the first of two articles. The subject of the second will be transatlantic freighting, with particular reference to the new services of Airwork Atlantic.**

# INTRODUCTION TO AIR FREIGHT

## *Part 1: The American Domestic Scene*

By ROBERT J. BLACKBURN

CIVIL aviation is the only major form of transport concerned more with people than with goods. Air cargo—the carriage of property by air—represented about three-tenths of the airlines' total traffic in 1954. This proportion is smaller by far than was predicted with such optimism and assurance in the immediate post-war era. More significant, however, is the fact that between 1952-1953 air freight traffic expanded by only four per cent and that the rate of increase further declined to three per cent in 1954.

Notwithstanding the success achieved with cargo aircraft in isolated areas where, for geographical reasons, they enjoy an economic advantage over surface transport, it remains broadly true that air freighting is incidental and supplementary to the carriage of passengers by air.

Every form of transport has passed through the stage where the flow of goods surpassed in volume the flow of passengers which preceded it. It is widely assumed that aviation will follow the evolutionary path of other forms of transport and that in time air freight will produce more revenue than air passengers. This is a comfortable assumption but its correctness depends on a great deal of intensive and intelligent planning by aircraft manufacturers and operators alike.

The future of air freight lies ultimately in the development of aircraft capable of working economically at a fraction of present rates—and immediately in the degree of effort made to attract new business with present equipment. Even in air-transport circles it is not yet fully appreciated that air freight must be sold far more intelligently than any other service offered by aviation because so many of its advantages are hidden.

The first serious steps towards operating scheduled air freight services in competition with highly developed surface transport began in the United States about ten years ago. North America sustains more than half the world's scheduled air transport, and its airline industry is not only the largest but, economically, the healthiest. The major carriers are financially independent and their services are cheaper, relative to the value of personal time and to personal earnings, than in any other region of the world. This fact is frequently illustrated by quoting seat-mile costs for different countries, but straightforward comparisons on this basis do not tell the whole story. It is pertinent to observe that the average weekly earnings of an employee of one major American airline are approximately equivalent to the cost of a one-way air ticket from New York to San Francisco (2,600 miles), whereas his counterpart with one of the better-paid European airlines earns in the same period a sum equivalent to the single fare for an air journey from London to Frankfurt (400 miles). The disparity between these distances is not due solely to differences in salaries nor to differences in travelling cost, but to a combination of both.

Only under exceptional circumstances will a piece of freight bear the same transport cost as a passenger. Lower rates, therefore, must be offered in order to attract a worthwhile volume of cargo traffic. Fortunately, the airlines can afford to do so since a cut-rate load in the cargo compartment is better than an empty space beneath the cabin floor. The amount of freight normally carried by a passenger aircraft is not large, rarely exceeding four or five tons. The frequency and density of service, however, over the United States' domestic network represents a sizeable airlift of freight alone, even though the services are operated primarily for the benefit of passengers who make up the majority load.

Thus, there has existed in America for some time a firm foundation for the construction of an all-freight air network—initially on the densest routes between major centres of population and industry. It is a well-known fact that most of the world's airlines are still experiencing great difficulty in making passenger

*Surrounded by typical items of loading equipment, the DC-6A Liftmaster above is one of three operated by American Airlines. (Below) About 65 per cent of American's freight traffic is carried on "combination" aircraft, including the DC-6B (right) and Convair 240.*

*(Above) the scene of this sequence is the American Airlines freight terminal at La Guardia. The receiving dock (left) admits freight at truck-bed height. Loads are moved into the building by roller conveyor, palletized and fork-lifted into destination racks.*

## INTRODUCTION TO AIR FREIGHT . . .

services pay their way even with the aid of mail subsidies. One may readily appreciate, therefore, the problems of operating all-freight aircraft (which, incidentally, were not designed as freighters from the outset but were adapted from passenger-carrying airliners) when the yield per ton-mile is only half or one-third of that earned by the passenger-carrying aircraft.

In America three types of traffic are grouped under the broad title of air cargo:—(1) air freight; (2) air express; (3) air mail. Air freight, with which this article is primarily concerned, differs from (2) and (3) in that the airline is the carrier and frequently the selling agent also. Freight space is sold in the same way as passenger space though the load is handled and stowed in a different way and is carried for a lower fare.

In the case of air express, the carrier is the Railway Express Agency Inc. (Air Express Division), whose use of the airlines as sub-contractors is incidental to the Agency's basic function of selling a competitive door-to-door delivery service. The Agency does not discriminate between airlines and consigns its loads on the fastest and most convenient flights available. Nor is there any contract between the public and the airlines in the case of air mail, which is a service offered by the Post Office for the high-speed delivery of cards, letters, printed matter and parcels.

There seems no reason why the bulk of express and mail traffic should not always be carried as supplementary loads on passenger aircraft. By contrast, the all-freight service is aviation's equivalent to the goods train or cargo ship, carrying bulky loads at relatively low rates.

During a recent visit to America the writer was able to study at first hand the air-freight operations, methods and business philosophy of American Airlines. To do so was to obtain an introduction to most aspects of this many-sided subject. There were good reasons for selecting this particular airline, as the following notes on the company's background will show.

American Airlines are in most senses the largest airlines in the world. When the company's current re-equipment programme is completed in 1957 its fleet will consist of 206 aircraft, including an all-freight division of 16 machines—nine DC-4s and seven DC-6As. America's present all-freight fleet consists of nine DC-4s and four DC-6As. In terms of both passenger and cargo ton-miles the company has a larger turnover than any other airline; seats on its aircraft are now sold at the rate of nearly six million annually. Freight and express ton-miles flown by American Airlines in 1954 amounted to nearly 65m—more than the *total* ton-miles (passenger, freight and mail) flown on the scheduled services of B.E.A. and all British independent operators during the same period.

American Airlines inaugurated all-freight services, with converted DC-3s, in October 1944. DC-4 freighters were introduced in June 1946 and DC-6A Liftmasters—the first aircraft built specifically for long-range cargo work—came into service in May 1953. Since the introduction of those DC-3 services A.A's freight traffic has grown enormously—from 2m ton-miles in 1944-45 to over 30 times that total last year. It is important to note that these figures include the freight carried on passenger services and that the working capacity provided by the all-freight division is still supplementary to that of the main fleet.

The nine DC-4s and four DC-6As are today carrying about 35 per cent of A.A.'s total freight and express traffic. They are operated over a carefully planned network embracing one-fifth of the 77 cities served by American Airlines—including, of course, such major traffic centres as New York, Buffalo, Detroit, Chicago and Los Angeles.

The backbone of the all-freight network is the trans-continental route between New York and Los Angeles, which is flown nightly by DC-6As to give next-day delivery to consignees on either side of the continent. Calls are made at Detroit and Chicago in each direction.

The price of air freight relative to the other types of service operated by American can be gauged from the earnings in cents per ton-mile (a cent is worth 0.8 pence) in 1954. These were: passenger, 54 cents; mail, 39 cents; express, 37 cents; freight, less than 22 cents. This figure of 22 cents per ton-mile is the

*Unloading a DC-4 freighter at Newark Airport the "scissors" truck is one of many types of handling equipment used at U.S. terminals.*

***Outbound loads are conveyed by fork-lift (left) to all-freight aircraft parked outside the terminal or by cart to the passenger apron, for stowage in combination aircraft. The final scene (right) shows the rear hold of an all-freight DC-6A.***

average yield, though individual rates vary (according to distance, direction and type of load) over a range of approximately 16 to 24 cents. In exceptional cases air freight is carried for as little as 12 cents per ton-mile.

To put these costs into some kind of perspective it may be added that road-transport charges for the class of goods carried by air are in the region of 6 to 7 cents per ton-mile, and that equivalent rail rates are perhaps 3 to 5 cents.

The earnings of transatlantic carriers are now standing at about 40 to 44 cents per ton-mile of air freight. Air freight is still in an early stage of development on the relatively short and low density air routes of Europe, and this is naturally reflected in high rates and a low volume of traffic.

A shipper in New York pays about $6 to have a 100 lb consignment flown 500 miles to Detroit; a London merchant will pay the equivalent of $6 45 cents to have a similar consignment air-freighted from London to Paris—a distance of about 230 miles. Similarly, the charge for air freighting a 100-lb load from New York to Los Angeles (about $25) is little more than the rate for sending the same shipment by air from London to Rome, even though the distances involved are, respectively, 2,500 and 900 miles.

The problems faced by the operator—and his solutions to them—are reflected in the pages of the air-freight tariff. A fundamental difficulty is that most freight travels only once; return loads are not guaranteed. The rate charged must, therefore, be reduced when necessary to attract some kind of load aboard an aircraft which would otherwise return to its base empty after a profitable outward trip. Thus, 50-odd commodity groups are listed in the American Airlines freight tariff, and it will be seen, for example, that fruit and flowers from the West Coast can be shipped to New York at a more favourable rate than clothing or electrical parts moving from the industrial east to the agricultural west. A second reason for the commodity-rate system is, of course, that reduction of a cent or two may turn the scales in the airline's favour when competing with a surface carrier for a large contract.

Handling costs vary according to the size of load carried, and the tariff system covers this problem by the incorporation of "break-points," which define the minimum weights at which various bulk discounts apply. Break-points vary with the type of commodity and the route. Normally, however, the first discount is offered for loads of about 50 lb and in some cases there are further break-points at 1,000, 2,000, 3,000, 5,000 and 10,000 lb. The economy of American air freight is thus largely based on the carriage of items weighing at least 50 lb and consignments below this weight can generally be considered as being more suitable for shipment *via* the air express service.

At this stage the freight forwarder makes his appearance. The forwarder's function is to consolidate a number of small separate items into a single shipment which exceeds the break-point weight and thereby qualifies for a discount which the airline cannot offer to the individual shipper. The forwarder receives the whole discount, allows part of this to the customer and pays himself with the balance.

In New York, Los Angeles and Chicago, forwarders feed in a sizeable proportion of the freight flown out of these cities by American Airlines—probably 25 or 30 per cent in the case of New York.

Contrary perhaps to general belief, most air-freight revenue comes from consignees rather than consignors. Something like 90 per cent of American's freight traffic is routed by consignees.

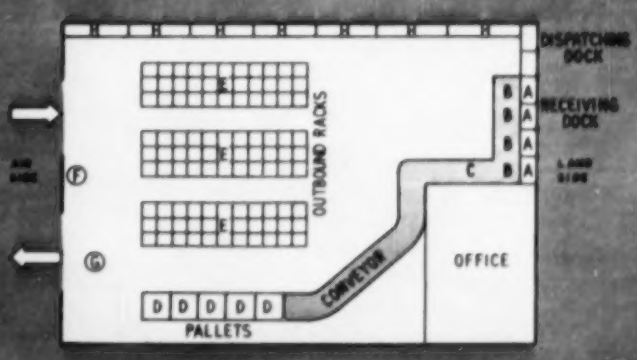
Unlike air express, air freight is essentially an airport-to-airport service. Rates are based on the cost of carriage between airports, though for an additional charge truck delivery is available to and from any airport; the airline does not itself maintain vehicles for this purpose and allocates the work to local transport services.

The question "What sort of goods are moved by air freight?" is answered by the list overleaf. It separates into 20 categories the total freight uplifted by American Airlines during one month of 1954. The diversity of the list is its most impressive feature, indicating that air freight is being appreciated and used in a wide cross-section of American industry and agriculture.

Progress so far in the United States has been encouraging, but

***Airbill, envelope and list label.***

***(Below) Diagrammatic layout of the La Guardia terminal:—***
***Freight is accepted at A, and weighed, identified and rated at B. The airbill is completed at C and placed in an envelope which is taped on to the consignment (when several consignments move under a single airbill, list labels are used). Loads are assembled on wooden pallets (D) and warehoused in racks (E) according to destination (the La Guardia racks have 66 divisions). Loads assigned to combination aircraft are placed in carts at F and towed out to the apron. Consignments for all-freight aircraft are pre-assembled at G and taken out by fork-lift for on-loading. Inbound loads are stowed at H for delivery or placed in the racks for onward shipment.***



*The American Airlines freighter fleet consists of nine DC-4s . . .*

## INTRODUCTION TO AIR FREIGHT . . .

| Rank | Commodity | Ton-miles | Percentage of Total |
|---|---|---|---|
| 1 | Wearing apparel (except footwear and furs) | 442,938.3 | 9.32 |
| 2 | Automobile parts or accessories | 352,880.5 | 7.43 |
| 3 | Machines or machine parts | 330,400.1 | 6.96 |
| 4 | Cut flowers | 272,546.6 | 5.74 |
| 5 | Electrical equipment or parts | 255,117.8 | 5.37 |
| 6 | Articles (unspecified) | 215,811.7 | 4.54 |
| 7 | Photographic film | 203,138.4 | 4.28 |
| 8 | Aircraft parts or accessories | 149,354.5 | 3.14 |
| 9 | Metal bars, castings, sheets or ingots | 99,423.1 | 2.09 |
| 10 | Biologicals, drugs, medicines and pharmaceuticals (including blood plasma and whole blood, and serums and vaccines) | 94,077.7 | 1.98 |
| 11 | Footwear | 86,036.7 | 1.81 |
| 12 | Printed matter (general) | 84,050.5 | 1.77 |
| 13 | Newspapers | 75,089.0 | 1.58 |
| 14 | Vegetables, fresh (not cold-pack nor frozen) | 68,304.6 | 1.44 |
| 15 | Advertising display material or advertising matter | 66,639.6 | 1.40 |
| 16 | Dry goods | 57,152.5 | 1.20 |
| 17 | Diplomatic pouches | 56,443.2 | 1.19 |
| 18 | Electric motors | 50,389.2 | 1.06 |
| 19 | Radio and phonograph sets or parts | 49,285.3 | 1.04 |
| 20 | Electrical appliances or parts | 49,270.8 | 1.04 |

*Freight carried in a typical month by American airlines.*

air freight is still an immature industry, using makeshift equipment, and this fact is freely acknowledged. The super-modern freight terminal is very much a rarity and most of the plans for building new terminals are rather nebulous; it is difficult to provide for the requirements of an industry which is certain of ultimate success but cannot yet predict how or when it will be achieved.

We illustrate here the American Airlines freight building at La Guardia, which exemplifies victory of adaptability and enthusiasm over barely adequate facilities. This terminal has handled up to 100 tons of outward freight alone in a single day—and most of the work-load is concentrated in the four-hour evening rush period. The airline would naturally like to spread its traffic more evenly over the full 24 hours, but must accept as largely inevitable the industrial customer's practice of sending his goods to the airport at the close of the working day for next-morning delivery.

The DC-6As in service with American symbolize their owners' belief in the potentialities of air freight because, unlike all other aircraft of their type, they are not fitted with cabin windows and therefore cannot be adapted for passenger work. Four more DC-6As will be added to the fleet early next year, considerably increasing the company's freighting capacity and providing extra reserve to meet local and seasonal peaks. On several occasions demand for freighting capacity has exceeded supply, notably in November and December.

The DC-6A has a cruising speed of about 300 m.p.h. and will carry up to 32,500 lb payload. It has large double loading doors and the cabin is fully pressurized—an essential feature of any modern long-range freighter. The DC-4, which cruises at up to 240 m.p.h., has a maximum payload of about 20,000 lb.

*. . . and three DC-6A Liftmasters. Four more DC-6As are on order.*

Among aircraft which can be regarded as the next generation of freighters, the most likely candidate is the turbo-powered Lockheed C-130. In the air, it promises to have a much lower ton-mile cost than the DC-6A; on the ground, economy will further benefit from simplicity and speed of unloading its low-slung, capacious fuselage. Range, payload and flexibility are essential attributes for the economic air freighter, and cannot be sacrificed to speed for its own sake. The aircraft capable of 300-400 m.p.h. provides the operator with all the speed he needs to compete against railways and roads in terms of delivery *time;* the efficacy of this competition now depends on delivery *costs*, and will continue to do so for many years.

Cargo specialists of American Airlines feel that a high proportion of their present business must still be classified as "emergency" shipment, which can never be the basis of a thriving, large-scale air-freighting industry. They contend that not only is the world at large unaware of the significance of air-freighting, but that air transport is itself only beginning to appreciate its possibility. It is not enough, the argument runs, to set before the potential customer a list of the theoretical advantages of air freight, leaving him to work out for himself whether or not they offset the higher cost of transportation.

In a series of lectures and articles, American Airlines executives have put forward their belief that 60 cents of the average manufacturing dollar is accounted for by distribution costs, and that, furthermore, many manufacturers have no more than a hazy idea of how those costs are made up. They argue that the use of air freight must be scientifically studied in relation to the entire distribution process, and that if the customer has no inclination to perform such a study the airline must do it for him, presenting the case for air freight with a set of indisputable figures.

This theory is now being applied by the largest and most progressive operators. American Airlines have set up an air-freight development branch staffed by a cadre of selected salesmen who receive an intensive and lengthy course in distribution economics. These men are equipped to meet industry on its own ground and address it in its own language. Six months or more may be spent investigating the distribution methods and economics of a company which appears to the airline to be potentially a large-scale user of air freight.

Most of the advantages of air freight are well-known, though their financial value relative to a specific industry is rarely obvious. They are defined by American Airlines as "greater speed, greater security and protection in transit and more efficient and simple methodology in its use." Each of these basic characteristics has functions affecting the process of distribution and, thus, the final decision as to whether the introduction of air freight is economically desirable.

The airlines can claim that they have redrawn the map of practically any area of the world, and that no two p'aces in any continent are separated by more than two, or at the most three, days' total delivery time. This speed greatly reduces the need for warehousing and inventories, and can offer a manufacturer new markets as well as increasing his sales in existing markets. Reduction of warehousing and inventories results in less stagnation of capital and lower freight-handling costs and, in turn, lowers the depreciation of goods in transit between the producer and the customer (since the transit period will in many cases be shorter).

Packaging of goods for air shipment is frequently lighter than for other forms of transport and never heavier. Goods are exposed to damage for a much shorter period of time, and for this reason there is also less likelihood of deterioration or pilfering. American Airlines state that damage to shipments in transit costs only 0.28 of 1 per cent of total freight revenues, and that the corresponding figure for loss caused by theft is 0.23 of 1 per cent.

It can be assumed that there are three cases where existing users of surface transport would consider the change to air freight. In the first case, when freight rates are the only variable, the decision will be made on a straightforward comparison of charges. In the second case air freight rates may be considerably higher but some of the factors mentioned above may justify the switch to air freight, even though the volume of business does not change. In the third case the value of new business resulting from the use of air freight may exceed the additional transport charges.

A fourth field of opportunity lies ahead. The future will bring new forms of business and industry owing their birth to the existence of air transport. Such enterprises will enjoy an advantage denied to older-established competitors; they will start life with the knowledge that air-freight brings a manufacturer to the doorstep of his most distant customer, and they will plan accordingly.

The beginnings of this trend can already be detected in America, where quality of air service is beginning to be taken as a major factor in the choice of location for new towns and factories.

*The first prototype of the Caravelle after it had been wheeled out on April 21st.*

# The S.N.C.A.S.E. S.E.210 Caravelle

## *France's First Jet Airliner*

THE first jet airliner to emerge from the French aircraft industry as a complete commercial project is the S.E.210 Caravelle. The prototype, F-WHHH, was rolled out on April 21st and is now undergoing a thorough ground-check, including engine runs and taxying trials. It is expected to make its first flight in the very near future. Work started in February 1953, when metal was first cut and actual assembly began one month later when the first pieces arrived at the S.E. experimental hangar at Toulouse-Blagnac. The project was originally proposed in November 1951 when the Service Technique of the French Government, the Ministry of Transport and several aircraft companies met to formulate a specification.

The requirement was for a new medium-range transport with an all-up weight of 35 to 40 tonnes (77,000 to 88,000 lb) powered by any French turbojet then available. Besides the Caravelle, five other projects were formulated and submitted, but for one reason or another all but the Caravelle were eventually dropped. S.N.C.A.S.O. and Bréguet designs were not proceeded with; a Latécoère design required by-pass turbojets, but none was then available; a S.N.C.A.N. design was held up for a similar reason; and the Hurel Dubois 45 was initially accepted.

S.E. decided to use the Atar, which was then able to deliver 2,800 kg (6,170 lb) thrust, but this required the use of three engines; so extensive studies were made to find a suitable power plant layout. Since the third engine would obviously have to be installed on the centre-line, the tail suggested itself and it appeared that there was much to be gained from grouping all three engines there.

Wind-tunnel tests showed that the problems of such an unusual arrangement were far less than might be expected and that there were even a number of very significant advantages. The wing would be clear of all aerodynamic and structural interference from the engines (either podded or buried) and the flaps would likewise benefit. Since all fuel would logically be held in the wing, the fire risks would be greatly reduced by the separation of tanks from engines. Noise levels in the cabin also promised to be exceptionally low. The change of intake angle of attack with wing angle of attack for engines mounted in the tail is half that for engines mounted in pods under the wing and fuselage. In the event of wheels-up landing, the fire risk would be small, due to the wide separation of engines and tankage, and also because the engines would not touch the ground. The asymmetric power case would also be simpler, and the company claims that full thrust from one engine only at take-off can be held with 6 deg of rudder.

By April 1952 the project had been finalized and detail design began on the Caravelle and on the Hurel Dubois H.D.45 high-aspect-ratio jet transport. This latter design now appears to have been dropped, leaving the Caravelle alone in the field.

In 1952 it became apparent that engines of considerably greater power than the original Atar would be available in time for incorporation in the Caravelle. The company therefore decided to make use of what seemed likely to become one of the standard NATO power plants, namely a late mark of Rolls-Royce Avon. The thrust which could be expected was 4,200 kg (9,260 lb) and two of these engines would give as much power as the three originally considered. No change in the basic layout was made and Avon RA. 26s were eventually chosen. It might be argued that if three RA. 26s had been installed the Caravelle's performance and range would have been greatly increased, but this, the company claims, would bring the Caravelle into direct rivalry with the Comet 3; there is no intention of taking this course, or of going beyond the original specification for a medium-range transport.

At the beginning the S.E.210 was to be called Annapurna, but early in its history this name was changed to Caravelle and has remained so since. At the time of *Flight's* visit to Toulouse it was intended that the Caravelle should be demonstrated in flight at the Paris Salon in June and the test schedule has been arranged so that the necessary ten hours' flying will be completed in time for the show.

There are at the moment no firm orders for the Caravelle, but construction and tooling are being planned for a probable run of 50 aircraft. With this in mind, the second prototype is scheduled to fly 10 months after the first, and the first production aircraft could be ready for delivery in January 1958. Constructors' flight trials should take 500 hours, followed by a period of tests by pilots and technicians of the Centre d'Essais en Vol. After that an operator (and there is a strong feeling that it will be Air France) will carry out a further 1,000 hours of range, endurance and proving flights.

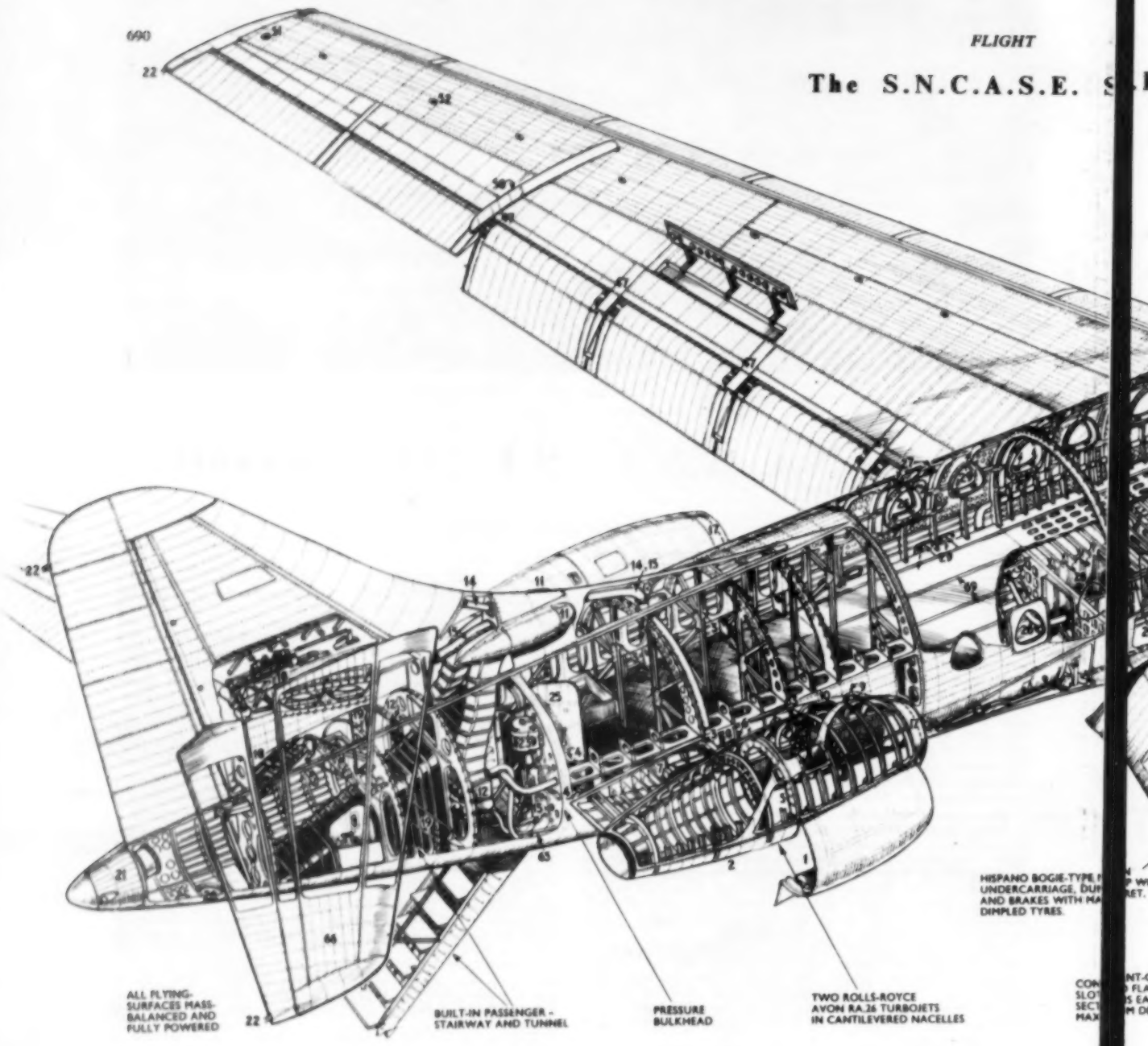
Despite the fact that there are no orders yet, it is noteworthy that Air France has taken a constructive part in the Caravelle project since its beginnings. An electrical expert, a structural engineer and a pilot have been attached to the company for some time past in an advisory capacity, and co-operation between the two organizations has been close and continuous.

The participation of a commercial operator in the design from such early stages gives promise of an excellent result. Even in the partly clothed skeleton of the aircraft many points could be noted which showed careful thought and ingenious design. The control system, in particular, gave the appearance of being a real "copy book" layout.

The design of a jet airliner, particularly in view of the events of last year, would appear to be a difficult task indeed. When many of the critical sections of the Caravelle were in the design stage, less was known about the behaviour of such parts in service than is now the case. S.E. have, however, been able to benefit in this respect from a close liaison with de Havilland's in England, and a number of features of the Caravelle have been prepared in the light of the English company's experience.

The question which particularly came to mind when *Flight* visited Toulouse was that of the qualities of the pressure cabin and the strength of the windows and cut-outs. Naturally the now customary tank-tests were mentioned. S.E. had, of course, already

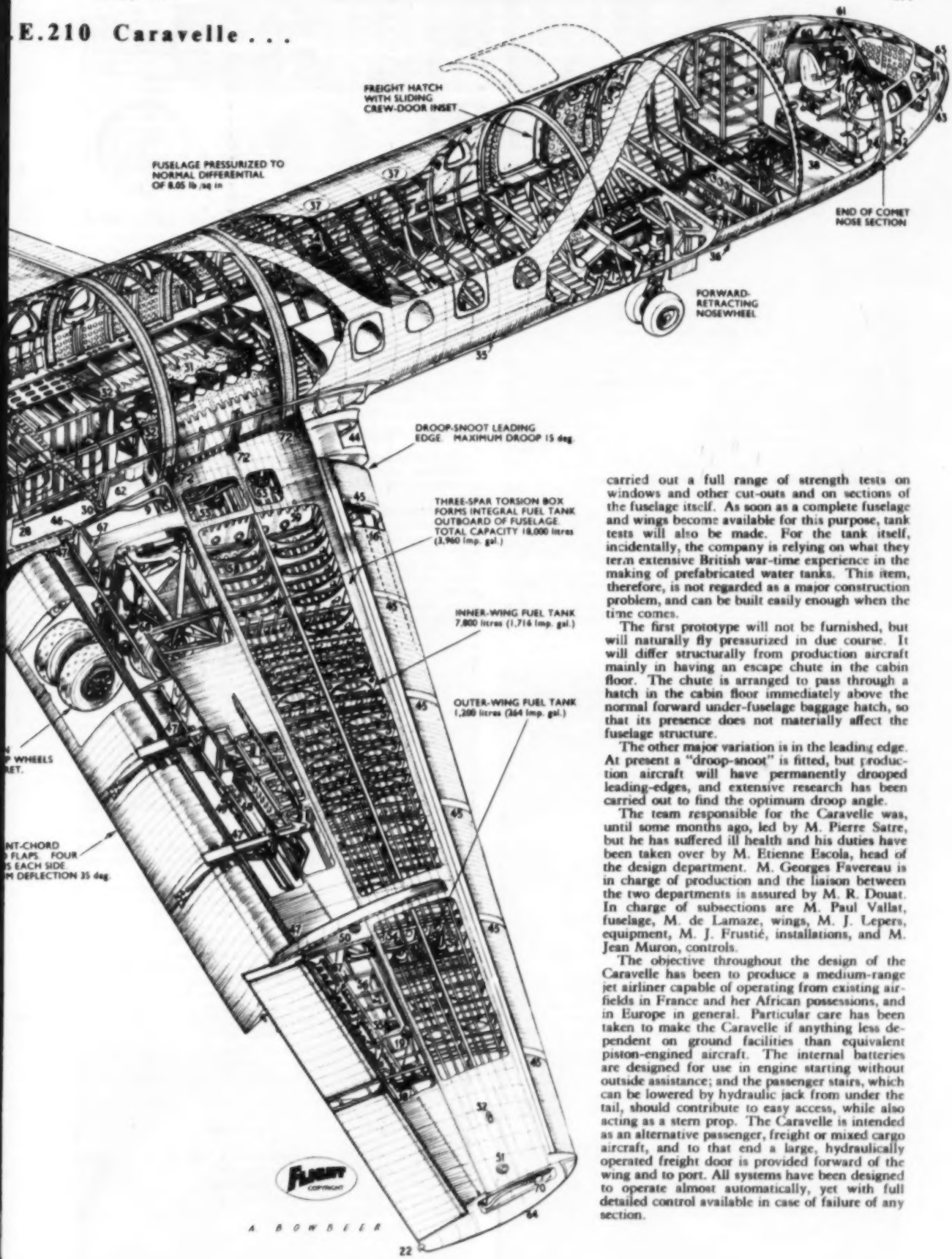
# The S.N.C.A.S.E. S




## KEY TO DRAWING

1 Hinged lower cowling.
2 Removable lower cowling (upper sections fixed).
3 Front and rear engine-suspension frames.
4 Tie-bars to pressure bulkhead.
5 Transverse firewall.
6 Longitudinal firewall (and rib of "stalk").
7 Generator.
8 Hydraulic pumps.
9 Main fuel supply pipe.
10 Fuel heater.
11 Intakes to air conditioning heat-exchangers (12).
13 Stairway operating-jack.
14 Fin de-icing air.
15 Tailplane de-icing air.
16 Wing de-icing air.
17 De-icing air around engine intake.
18 Powered-control Servodyne units.
19 Control cables.
20 Manhole.
21 Tail braking-parachute.
22 Zero-length static dischargers.
23 Hydraulic reservoir (blue system) (green to port).
24 Hydraulic reservoir (red system).
25 Passenger door in pressure bulkhead.
26 Nine emergency exits (total windows, 28).
27 Handgrips for use during feet-first exits.
28 Fuselage centre caisson (pressure walls, undercarriage bay).
29 Conditioned air-flow.
30 Main undercarriage up-stop.
31 Mainplane centre-line joints.
32 Centre caisson/box-spar joints.
33 Door to forward underfloor freight hold.
34 Wing icing inspection-light.
35 Hydraulic freight-door control and jack.
36 Nosewheel doors (closed until retraction begins).
37 Suppressed D/F. loops.
38 Radio racks, port and starboard.
39 Step down to flight deck.
40 Contact-breaker panel.
41 Comet-type seats and flying controls.
42 Emergency hydraulic pump.
43 D.M.E. strip-aerial.
44 Aerial compartment in leading edge.
45 Droop-snoot screw-jacks (six each side).
46 Flap-jack driving shaft.
47 Flap screw-jacks.
48 Air-brake jacks.
49 Automatic slot-covers.
50 Inboard fuel tank gravity filler.
51 Outboard fuel tank gravity filler.
52 Fuel gauges (capacitance type, nine per wing).
53 Pressure refuelling valves (under tank).
54 Pressure refuelling valves (outer tank).
55 Pressure refuelling control panel (hinges down).
56 Inspection panels (open).
57 Mass balances (elevators similar).
58 Lower half-ribs (tops not shown).
59 Wing stringers (all extruded).
60 Nosewheel steering wheel.
61 Direct-vision panels.
62 Mainwheel door closed for ground clearance.
63 Fire-suppression bottles (not shown) in this bay.
64 Detachable wing-tip.
65 Accommodation for collision warning radar and twin lights.
66 Spot-welded spanwise stringers, riveted ribs.
67 False rear spar.
68 Main undercarriage jack.
69 Seat-rails.
70 Tank air-vent float-valve.
71 Nosewheel jack.
72 Main-frame/box-spar joints.

# .E.210 Caravelle . . .


FREIGHT HATCH WITH SLIDING CREW-DOOR INSET
FUSELAGE PRESSURIZED TO NORMAL DIFFERENTIAL OF 8.05 lb /sq in
END OF COMET NOSE SECTION
FORWARD-RETRACTING NOSEWHEEL
DROOP-SNOOT LEADING EDGE. MAXIMUM DROOP 15 deg.
THREE-SPAR TORSION BOX FORMS INTEGRAL FUEL TANK OUTBOARD OF FUSELAGE. TOTAL CAPACITY 18,000 litres (3,960 Imp. gal.)
INNER-WING FUEL TANK 7,800 litres (1,716 Imp. gal.)
OUTER-WING FUEL TANK 1,200 litres (264 Imp. gal.)
P WHEELS
RET.
NT-CHORD
FLAPS. FOUR
S EACH SIDE
M DEFLECTION 35 deg.
FLIGHT
COPYRIGHT
A BOWDLER

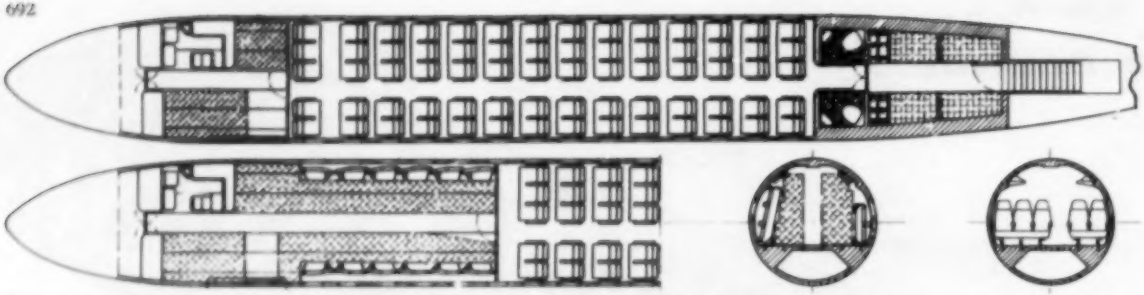
carried out a full range of strength tests on windows and other cut-outs and on sections of the fuselage itself. As soon as a complete fuselage and wings become available for this purpose, tank tests will also be made. For the tank itself, incidentally, the company is relying on what they term extensive British war-time experience in the making of prefabricated water tanks. This item, therefore, is not regarded as a major construction problem, and can be built easily enough when the time comes.

The first prototype will not be furnished, but will naturally fly pressurized in due course. It will differ structurally from production aircraft mainly in having an escape chute in the cabin floor. The chute is arranged to pass through a hatch in the cabin floor immediately above the normal forward under-fuselage baggage hatch, so that its presence does not materially affect the fuselage structure.

The other major variation is in the leading edge. At present a "droop-snoot" is fitted, but production aircraft will have permanently drooped leading-edges, and extensive research has been carried out to find the optimum droop angle.

The team responsible for the Caravelle was, until some months ago, led by M. Pierre Satre, but he has suffered ill health and his duties have been taken over by M. Etienne Escola, head of the design department. M. Georges Favereau is in charge of production and the liaison between the two departments is assured by M. R. Douat. In charge of subsections are M. Paul Vallat, fuselage, M. de Lamaze, wings, M. J. Lepers, equipment, M. J. Frustié, installations, and M. Jean Muron, controls.

The objective throughout the design of the Caravelle has been to produce a medium-range jet airliner capable of operating from existing airfields in France and her African possessions, and in Europe in general. Particular care has been taken to make the Caravelle if anything less dependent on ground facilities than equivalent piston-engined aircraft. The internal batteries are designed for use in engine starting without outside assistance; and the passenger stairs, which can be lowered by hydraulic jack from under the tail, should contribute to easy access, while also acting as a stern prop. The Caravelle is intended as an alternative passenger, freight or mixed cargo aircraft, and to that end a large, hydraulically operated freight door is provided forward of the wing and to port. All systems have been designed to operate almost automatically, yet with full detailed control available in case of failure of any section.



*Cabin layout for 70 passengers (upper) and mixed cargo/passenger loads (lower). Shaded areas from front to rear are forward baggage compartment, w.c.s, coat-hanging space and rear baggage compartment.*

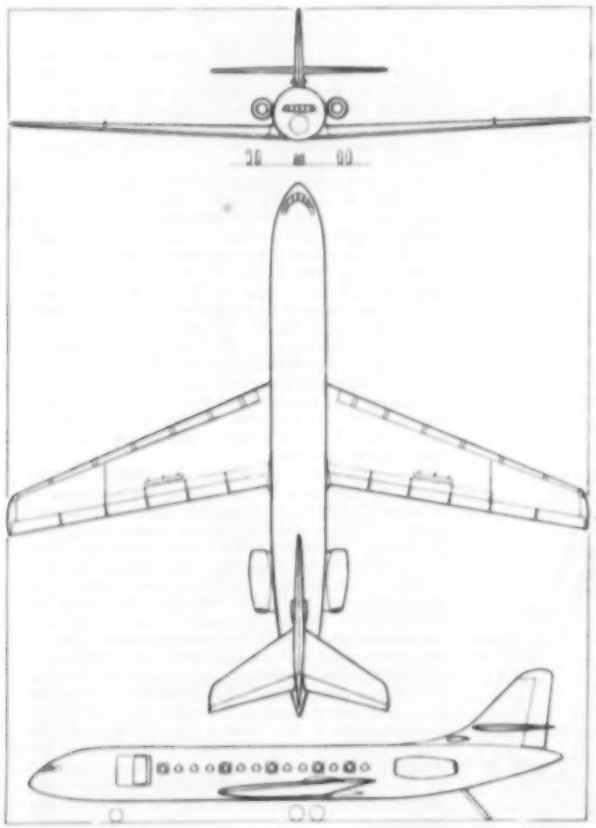
## THE CARAVELLE . . .

It is intended, at least in principle, that the flight crew should be two pilots only, but here the designers are up against the stated resolve of the airline pilots not to work two-man crews, and allowance is therefore made for a flight-crew of three.

Caravelle production is to be undertaken jointly by S.N.C.A.S.E. and S.N.C.A.S.O., with the latter company making the wings and the former in charge of assembly. The first cost of a Caravelle is estimated at 425 million francs (£439,000 approximately). The company is not prepared to make any estimate of operating cost, because of the great variety of conditions which influence such estimates. There are, however, a number of factors which will make for low costs—particularly the twin-engined layout, which decreases the fuel, maintenance and spares expenses. The crew is, moreover, small; it would normally consist of four, either two pilots and two stewards, or three flight crew and one steward.

The turn-round has been specially studied and simplified, particularly in regard to the equipment required. An important profit-making consideration is that maximum use should be made on all flights of the aircraft's freight capacity, and S.E. point out that, since the whole fuselage floor is strengthened for freight, the full payload can always be made up in this way. The volumetric capacity is equal to that of a DC-6.

Cockpit layout has been carefully prepared and, in so far as the basic systems are concerned, is virtually finalized. Radio installations and interior furnishing of the cabin are, however, being left entirely to the operator. A suggested radio installation would include Standard Telephones and Cables STR 18B H.F./R.T. and STR 12D V.H.F.; American Sperry C2A gyro-compass (its English Sperry equivalent was described in *Flight* on April 2nd, 1954); Lear L-5 autopilot (of which developments were described in *Flight*, February 18th); Marconi AD 7092D Radio-magnetic Indicator; Collins 51 R3 V.O.R. and I.L.S. localizer receiver and 51V2 glide-path receiver; Bendix MN 53B marker beacon receiver. All this equipment would naturally be duplicated.



### Structure: Fuselage

The fuselage is a stressed skin structure 103ft 4in long, including a cylindrical section of 51ft 8in with a diameter of 12ft 6in. The pressurized section measures 83ft 6in and has a volume of 6,003.8 cu ft. The passenger/freight cabin is 44ft 4in long, with a floor area of 430.5 sq ft and a maximum height of 6ft 8in. There are 28 windows, 11 of which are inward-opening escape hatches. Normal accommodation is for 70 passengers seated five abreast, but a high-density version could hold 91. There are two underfloor freight compartments, one measuring 21ft 4in by 2ft 3in, the other 18ft by 2ft; their combined capacity is 434.3 cu ft. In addition, there is baggage space forward of and behind the passenger cabin. Entry is by retractable stairway under the tail with an inward-opening door through the flat rear pressure-bulkhead, and freight can be loaded, without interfering with routine turn-round operations, through a freight hatch, measuring 6ft 6in by 5ft 11in high, on the port side of the forward fuselage. A small sliding door is inset.

There are 75 frames in the fuselage, of which 15 are reinforced. No. 7 marks the junction, immediately behind the windscreen, of the Comet nose-section with the S.E. fuselage. No. 13 picks up the nosewheel mounting and marks the forward edge of the freight door, whose rear edge is reinforced by frame 19. Nos. 31, 35 and 41 mark the wing/fuselage pick-up and Nos. 48, 51, 53 and 56 are frames braced by square-tube girders for engine and nacelle mountings. No. 60 is the flat cabin rear bulkhead, and Nos. 63, 65 and 69 pick up the spars of the fin. No. 73 marks the beginning of the tail-cone and holds the tunnel for the 22.4ft ribbon tail-braking parachute.

The fuselage is built in three sections: nose, tail-cone, and cylindrical centre section. The nose is built on a vertical jig, from stringers pre-shaped on a rotatable plaster forme, and with pre-formed skin sections. For production aircraft, these will be stretch-formed. The fuselage centre section is built up of a number of smaller components assembled in the main fuselage jig. The actual engine-mountings depend from frames 53 and 56, from which bridge structures pass over the top of the engines to pick up the mounting points. This leaves the lower half of the engine cowling structure free of main supports, and the forward section hinges downwards on its outer edge to provide access for servicing. The rearward portion under the tail-pipe is detachable by means of quick releases. The rear pressure bulkhead is located level with the engine effluxes and consists of two diaphragms heavily reinforced with radial webs to the rectangular door frame. The forward face holds cabin pressure and the rear face is liberally perforated with flanged lightening holes. On this rear face are mounted the blue and green hydraulic reservoirs; and on the sloping tunnel, which accommodates the steps when retracted, are mounted the heat-exchangers with their rectangular ducts leading downwards from the fin-root intakes. The main rudder hinge (and the beam, on which the rudder Servodyne is supported) depends from rib 69, which is reinforced by a built-up web structure.

At continuous level, the cabin floor is built up on transverse beams integral with each frame, supported by tube struts or, in areas of stress concentration, by square-tube girders. Two A.D.F. serial compartments are buried in the roof of the forward cylindrical fuselage section.

The wing pick-up structure consists of a series of joints, the principal of which lie at the ends of the truncated reinforced frames, Nos. 31 and 35. These pick up the upper booms of the forward and rear torsion-box spars, the skin in these areas being heavily reinforced. Lying principally within the fuselage, but aft of the torsion-box, the mainwheel bays are enclosed by a box structure which forms the pressure bulkhead system at this point. Between the two bays lies the central trunk for the control and electrical cables and ducts running longitudinally under the cabin floor. The control cable trunk continues forward through the main torsion-box junction.

The shape of the windows was determined by the fact that it was considered that most passengers looked downwards from the aircraft. In order to save weight, therefore, it was decided to make the top of each window an arched structure, resulting in the overall triangular shape. A saving of 40 kg (88 lb) over rectangular windows was effected despite the thickness of the double transparencies, which are 22 mm and 24 mm (0.87in and 0.95in). The tests carried out entailed the mounting of a single window in a small pressure chamber. In a straightforward test to destruction the window broke at a safety factor of 15. Next, the window was tested after a cross had been cut in it with a diamond. It then failed at a factor of 10. A third window was then tried over 10,000 pressurization cycles in conjunction with a temperature fluctuation of plus 50 deg C to minus 70 deg C. Once more, the safety factor was 15. A complete fuselage section including a window and an escape hatch was subjected to 40,000 pressurization cycles and at the end of this time no optical distortion or change of crystalline structure could, it is stated, be discerned in the window. The window frames are drop-hammered parts.

## Wings

The wing-span is 112ft 6in with an effective surface of 1,579 sq ft. The chord along the aircraft centre line is 20ft 9in and, at the tip, 6ft 4.1in. The aerofoil section is N.A.C.A. 651212 and the sweep-back at 25 per cent chord, 20 deg. Dihedral is 3 deg and the angle of attack at the centre line, 2 deg. There is a washout of minus 2 deg 11 min at the wing-tip.

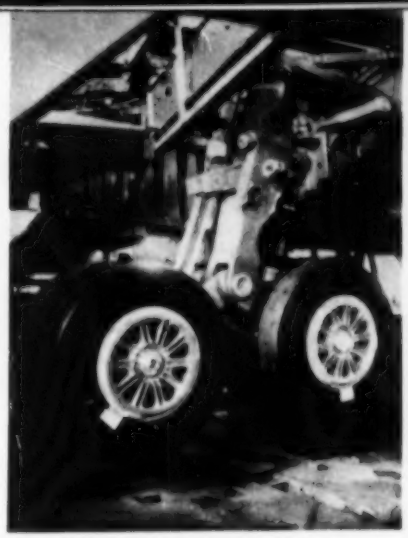
Effective area of the ailerons is 84.38 sq ft and the effective chord 27.45in. Extending rearwards and downwards to 35 deg, the flaps have an area of 265.8 sq ft. The droop-snoot leading-edge has a maximum droop-angle of 15 deg.

The wing ribs in each semi-span are numbered from 2 to 52, reading inwards from the tip. The principal load-carrying structure, containing the integral fuel tankage, is a three-spar torsion-box to which are attached the seven drooping nose sections, two aileron sections each side and a total of eight flap sections. A rearward extension structure carries a dummy spar and flap and aileron hinges made up of Warren girder ribs covered with sections of skin reinforced by spot-welded and glued stringers.

The main torsion-box is built up from the upper and lower skins. The inboard wing skin is made up of two taper-rolled sections (5 mm to 2 mm: 0.2in to 0.08in) and the outer portion of a single constant-thickness section (2 mm: 0.08in). Span-wise stringers are flush-riveted to the skin on a fixture, after which the crescent-shaped quarter ribs are added. In this part of the wing the ribs are built up of four crescent-shaped sections riveted to skin and to the three spar webs.

After the lower skin is built up with ribs and centre spar web, the upper skin (with the spar booms but without ribs) is offered up and the remaining rib sections inserted and riveted. The box is then sealed for fuel tankage space. There are a number of access panels in the webs of the main spars to allow inspection of the tanks and installation of pumps and pipes. The main undercarriage leg is mounted on a heavy triangulated structure behind the rear spar, through which structure the loads are transferred to the torsion-box by the specially machined booms of a heavily reinforced rib, No. 44.

The flap sections are built up separately, the stringers being spot-welded and glued with Araldite to the skin and joined into a continuous flap at each edge by the common mounting brackets.



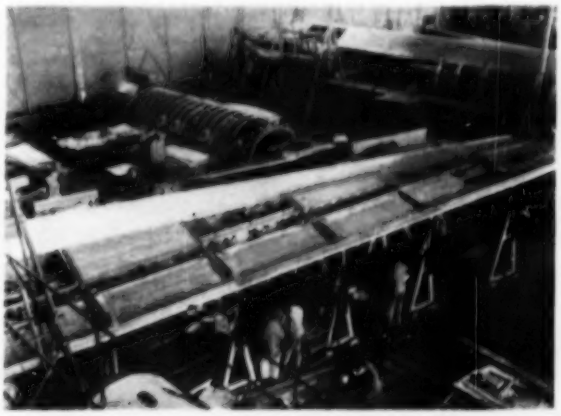
***The starboard main gear seen slightly from the rear. The Hispano leg is supported from the wing torsion box by a massive triangulated structure. Immediately behind it is the false spar which carries flap and aileron hinges. The wheels, disc brakes (equipped with Maxaret) and dimpled tyres are by Dunlop.***

They are extended outwards and downwards on rails by screw jacks driven by shafts running span-wise along the false extreme rear spar. An automatic, mechanically actuated shroud covers the flap slot as the flaps are retracted. It consists of long panels mounted on piano hinges with a spring linkage which a lug on the flaps strikes or releases as flaps go up or down. The ailerons are shrouded and mass-balanced and actuated by a Servodyne mounted between two closely spaced ribs which also support their central hinges. The air brakes are slats which extend above and below the wing; their lower (larger) section is operated by two piston-jacks and entrains the upper section through a mechanical linkage. Two boundary-layer fences are attached to the wing upper surface, running aft from a point just behind the forward spar to a point just aft of the aileron hinge line, between the ailerons and flaps.

The leading-edge flaps have a smooth outer skin and a corrugated inner skin, between which de-icing air flows, and are hinged at 15 per cent of the wing thickness. They are actuated in the same way as the flaps.

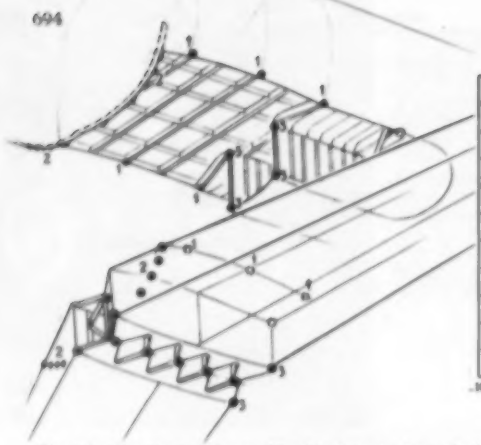
## Tail Surfaces

The vertical tail rises 14.4ft above the fuselage and has an area, less dorsal fin, of 166.8 sq ft. Rudder area is 59.2 sq ft and the aerofoil section is N.A.C.A. 65011. The fin is built up to

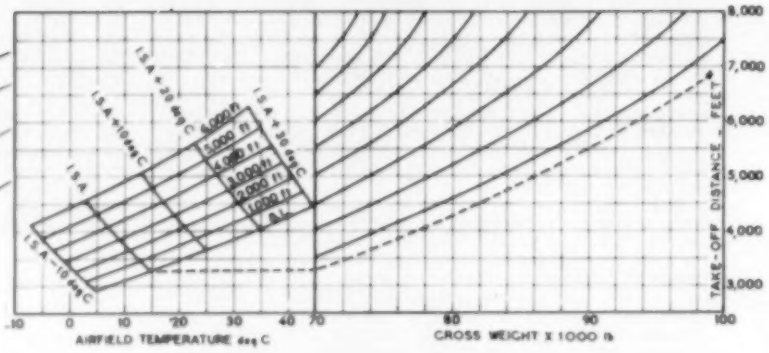


***Caravelle wing assembly. The wing extension aft of the torsion box is nearing completion, with flap panels and part of the ailerons already mounted behind the dummy spar. In the background the fuselage of the second prototype takes shape. (Below) The tailplane torsion box in place on the fin-base, which is integrally built with the fuselage.***

***Looking aft along the fuselage from just ahead of the main wing-fuselage junction. The floor is reinforced above the mainwheel bay.***



*The wing/fuselage pick-up. The black spots show (1) heavy fuselage frames bolted to top booms of torsion-box spars, (2) the front spar web bolted to a heavy sub-frame in the fuselage, shown dotted, and (3) the fuselage centre-caisson joined at its forward end to the root-ribs outboard of the wing centre-line joint.*




*Take-off distance in relation to airfield height and temperature. The dotted line shows the method of plotting.*

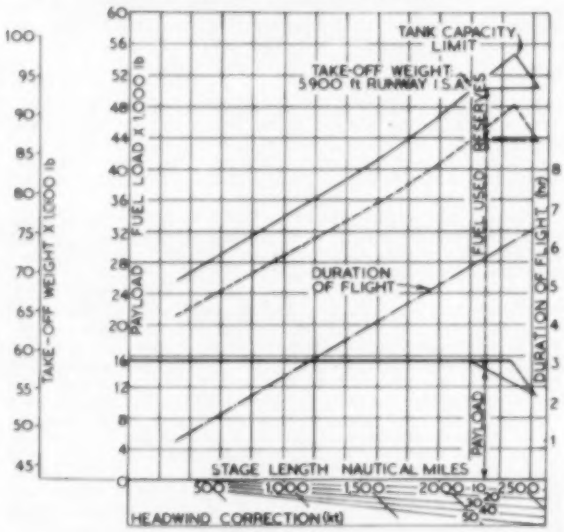
## THE CARAVELLE . . .

the level of the tailplane as an integral part of the fuselage between the reinforced frames 63 and 69. Forward of this the dorsal fin is added. To the top of this structure the tailplane, built in one piece, is bolted and on top of this again is the main fin. It is a two-spar structure built up as a torsion-box of lattice ribs, three of which carry rudder hinge-brackets built out from the rear spar inside a simple shroud structure. The rudder itself is horn-balanced and the hinges are not inset.

The tailplane has a span of 34ft 9in and an area of 301.4 sq ft. In order to achieve good control at high speeds, it has a greater sweep (30 deg at 25 per cent chord) than the wing and a smaller thickness/chord ratio. Like that of the fin, its aerofoil section is N.A.C.A. 65011. The elevator area is 69.42 sq ft.

The tailplane structure is very similar to that of the wing, consisting of a pre-formed skin with span-wise stringers (here spot-welded), on which double-crescent-shaped ribs inboard and simple profile ribs outboard are assembled in a jig. The two halves, upper and lower, are then joined together to form the torsion-box. Forward of this, the detachable leading-edge section with its hot air ducts is added and the elevator hinges are built out on extended ribs and masked by simple reinforced-sheet, tube-braced shrouds. The elevator itself is a single spar structure with a modified form of crescent half-rib construction inboard and plain ribs outboard. A series of mass-balanced weights are cantilevered out from the elevator spar within the shroud hinge compartment. It is on top of the central carry-through section of the tailplane that the elevator Servodyne is mounted.

*(Below) These curves for payload/range and fuel consumed show the estimated route performance of the Caravelle.*




### Performance

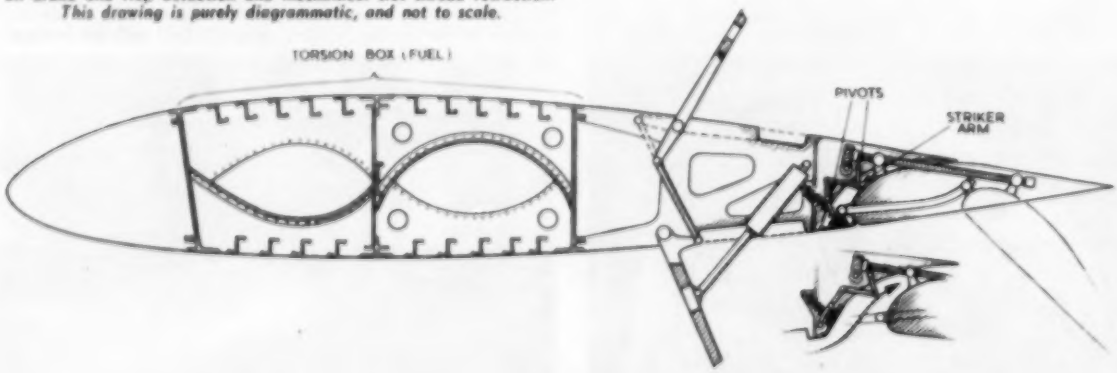
The company were not prepared to give more than the briefest estimate of aircraft performance before the prototype had flown. According to calculations, however, the structural Mach limit of the Caravelle is 0.87, and the stalling speed at maximum landing weight in the landing configuration is 87 kt.

Estimates of runway length required and payload/range have been subject to variation as improved versions of the Avon became available. The company's brochure gives two sets of performance graphs based on a thrust of 10,000 lb and 11,000 lb from each engine, and we quote here the figures for an engine of 11,000 lb static thrust. In addition, S.E.'s calculation of engine performance in hot air proved somewhat conservative and, according to the latest figures from Rolls-Royce, the take-off weight graphs have been modified. The curves for the latest estimates are shown in the accompanying graphs.

Cruising speed is estimated as 480 m.p.h. at 36,000ft and at a flying weight of 77,000 lb.

In the light of modern design methods, the systems in an aircraft are of major importance. Especially is this so in the case of the Caravelle, whose controls are entirely hydraulically operated. The hydraulic, electrical, air conditioning and pressurization and fuel systems will therefore be the subject of a separate article, to appear next week.

*A wing cross-section, showing the construction of the torsion-box with extruded stringers and spar booms, quarter ribs with riveted flanges, air-brake and flap actuation and mechanical slot shroud retraction. This drawing is purely diagrammatic, and not to scale.*



# Regularity in the Making

IT is unlikely that many passengers in B.O.A.C.'s Stratocruisers and other aircraft devote much thought to the unseen technical organization that ensures their comfortable and (usually) on-schedule journeys; or, if they do, very few can visualize the scale on which the organization operates. These two striking pictures by "Flight" photographer L. W. McLaren show scenes in the Corporation's new H.Q. building now in operation at London Airport. Above are Stratocruisers G-AKGH *Caledonia*, G-ANTY *Coriolanus* and two others undergoing routine maintenance. Below is the component repair and overhaul unit; this, large as it is, yet occupies only a comparatively small proportion of the vast new structure, which also houses administrative staffs.

# FLIGHT CONTROL

## —an Historical Review: Abstracts from Dr. Draper's Wilbur Wright Lecture

THE significance of the design of the Wright brothers' aircraft in relation to stability and control concepts was emphasized in the paper by Dr. C. S. Draper (of Massachusetts Institute of Technology) due to be presented yesterday, May 19th, before the Royal Aeronautical Society. The occasion was the Society's 43rd Wilbur Wright Memorial Lecture, given at the Royal Institution, London.

Before the Wright brothers demonstrated their powered man-carrying flying machine, Dr. Draper submitted, flight was based on the philosophy of vehicles with high inherent stability, combined with pilots whose only duty was to steer. This combination resulted in low controllability and poor manœuvrability, with a strong response to the disturbances of rough air. The Wright brothers broke away from the high-inherent-stability concept and combined inherently unstable aircraft with three-axis control operation by human pilots, to achieve stable flight systems with good controllability and good manœuvrability. This change from inherently stable to inherently unstable aircraft was the basic contribution made by the Wright brothers in starting the age of flight.

Dealing with aeronautics before the 20th century, the lecturer referred to Leonardo da Vinci, and also to Sir George Cayley who, in 1810, had described the essentials of a flying machine in some detail, including a discussion of stability in flight that correctly accounted for the effects of moments due to gravity acting at the centre of mass, and the centre of pressure as it moved over the wing surface in flight. Cayley had recognized the need for movable tail-surfaces to realize control in flight.

During the century following Cayley's work, the ultimate goal of all the pioneers in aeronautics remained to find a solution for the problem of man-carrying flight. Pénaud, Lanchester, Lilienthal, Pilcher, Chanute, Langley and Manly understood the need for stability in any flying machine, but they all followed the philosophy of making the machine inherently stable so far as possible, leaving the human pilot a job of steering similar to that in a ship. The high degree of inherent stability built into the gliders of Lilienthal, Pilcher and Chanute caused these craft to respond very strongly to gusts and variations in the wind, and also prevented the pilot from exercising enough control to correct effectively for deviations in orientation due to air disturbances.

### Complexity of Human Control

The actual process by which the human senses, brain, nervous system and muscles co-operate to move the body in carrying out the required continuous series of corrections in orientation (in a Lilienthal-type glider) was extremely complicated. The pilot could do an acceptable job only after (a) learning to observe required orientational corrections properly, (b) learning to give responses in the proper direction for stability, (c) becoming skilful enough to give these responses rapidly, so that deviations from equilibrium would remain acceptably small, (d) learning to establish desired equilibrium paths, (e) learning to issue internal command signals that caused proper components of the position of his centre of mass with respect to the aircraft to make the actual equilibrium path approach the command equilibrium path.

The success of Wilbur and Orville Wright in producing a practical powered man-carrying aircraft where others had failed was based not on directly visible features of their aeroplane but on a mental attitude that represented a clean break with a universally held dogma in aeronautical thinking. The brothers deliberately made their aeroplane with negative stability and depended on the human pilot to operate movable surface controls so that the flying system (consisting of pilot and machine) would be stable. In effect, the inherent abilities of human beings to observe and evaluate situations and to react swiftly with proper control motions were used to replace built-in aircraft stability. The all-important reward for requiring the pilot to provide essential functions in the stabilizing system was a great increase in manœuvrability and controllability of the aircraft as part of a flying system.

The lecturer went on to quote extensively from the writing of Wilbur Wright concerning the design philosophy behind the construction of the brothers' first powered machine. An early quotation read "The balancing of a gliding or flying machine is very simple in theory. It merely consists in causing the centre of pressure to coincide with the centre of gravity. In actual practice, there seems to be an almost boundless incompatibility of temper, which prevents their remaining peaceably together for a single instant, so that the operator, who in this case acts as a peacemaker, often suffers injury to himself while attempting to bring them together."

After discussing the control problems of the Wright machine, Wilbur described how the brothers had applied their new philosophy: "We would arrange the machine so that it would not tend to right itself. We would make it as inert as possible to the effects of change of direction or speed, and thus reduce the effects of wind gusts to a minimum. We would do this in the fore-and-aft stability by giving the aeroplanes a peculiar shape; and in the lateral balance by arching the surfaces from tip to tip, just the reverse of what our predecessors had done."

The inter-connection of the control surfaces about the roll and yaw axes on the Wright machine, the lecturer continued, made it effectively a two-control aeroplane, although in operation moments were applied about three axes. Since the time of the Wrights, it had become a fact of common experience that human pilots could co-ordinate three-axis controls, provide stability, and also cause their craft to follow accurately flight paths that they might elect to command. In clear weather, trained human pilots and normally unstable aeroplanes formed flying systems that left little to be desired in flight control performance.

When an earth geometrical reference was not available to the eyes of the pilot, however (i.e. when visual contact with the earth was lost because of night or bad weather conditions), one of the primary inputs for the pilot was lost and he became helpless as a sub-system for applying corrective actions for the aeroplane controls. This made it necessary to either provide substitute earth-reference information, or restrict flying to that under clear-weather conditions. The lecturer went on to describe the development in the U.S.A. of blind-flying instruments, from the Sperry rate-of-turn indicator of 1918.

### Co-ordinated Control Systems

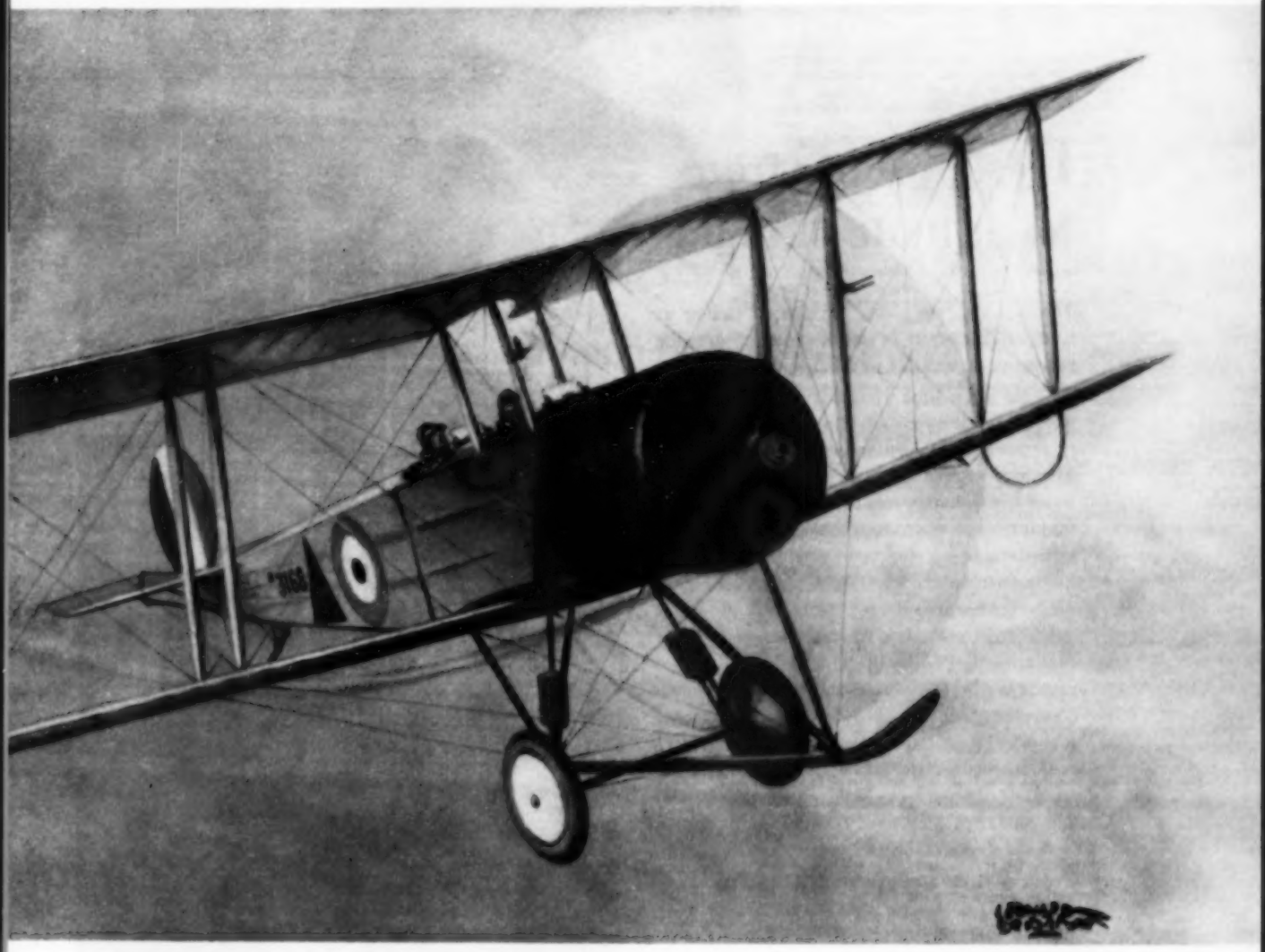
When the human pilot was a link in the flight-control system, the lecturer continued, he must co-ordinate his three controls when he introduced stabilizing corrections and also when he changed the orientation of his craft in causing it to follow flight commands. It was the necessity of reducing this co-ordination to the level of unconscious acts of skill that dictated the long hours of practice required to produce a qualified pilot, and even qualified pilots found it difficult or impossible to achieve satisfactorily stable flight from certain aeroplanes under some conditions of operation. Control forces might be too heavy, or the inherent instability oscillation might be too fast for the pilot's reflexes and the control-drive system to overcome. In such cases, yaw dampers, pitch dampers, stability augmentators, artificial stability systems or control co-ordinators might be employed—a realization of the pre-Wright Brothers' ideal of complete inherent stability for the aeroplane.

While control co-ordinating systems might reduce the efforts required of the human pilot in giving flight commands by means of his controls, even this duty was undesirable in that it required continuous attention. The remedy was recognized in the early days of flying to lie in the development of automatic piloting devices, to free the pilot from continuous routine operations so that he could devote his mental powers to evaluating situations and formulating decisions in both routine and emergency situations. An outline of American progress in the field of navigational auto-pilots was next given by the lecturer.

Automatic pilots of the present day, Dr. Draper continued, had adequate performance for navigational requirements when the primary objective of all aircraft operations was to land successfully at the intended destination. It was certain, however, that new performance requirements would lead to the development of flight-control equipment with radically new features. In air-to-air fighting, manœuvres of all kinds must be realized to the ultimate performance limits of fantastically fast and powerful aircraft. It was probable that the distinction between control co-ordinating systems and auto-pilots would disappear, so that an integrated flight-control system would actually become an essential part of a flight system that included the airframe and its propulsion system.

In conclusion, the lecturer presented in graphical form the main trends in the progress of flight-control developments. In this, the variation with time of interest and activity in flight control was shown, for each of the six types of flight-control system considered in the lecture. Other illustrations included functional diagrams showing the forces, signals and other factors involved in various flight-control systems.

## AS IT WAS . . .



**THE AVRO 504** was one of the World's great training aeroplanes. It was with the Type 504J—the original Mono-Avro—shown above, that the famous "Gosport" system of flying training was evolved by the R.F.C.'s School of Special Flying in 1917. In the years which have gone by since A. V. Roe & Company produced the first Type 504 dramatic changes have taken place in aircraft design. The Avro company is still in the forefront of progress with its remarkable Vulcan four-jet delta-wing bomber, now in priority production for the Royal Air Force.

*Still the pace quickens, and every new project brings fresh problems. Questions about fuels and lubricants to meet these increasingly exacting conditions are the constant concern of ESSO research groups whose information and advice are freely at the disposal of enquirers with problems in this field.*

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# Design starts from an attitude of mind

The real starting point of aircraft design at ENGLISH ELECTRIC is not a piece of drawing paper but an attitude of mind.

There was a time when admirable aeroplanes were designed by drawing (and re-drawing) until their nicely flowing curves were good to look at. This simple philosophy lasted surprisingly long, but it had unhappy side-effects. It inspired some unthinking people to believe that the intuition of an artist was a satisfactory substitute for the enquiring mind of the scientist. What worked—generally, but not always—in the low-subsonic piston age doesn't work today. Today there is *no* substitute for knowledge. Today the tools of the design team are the same as the tools of the scientist—analogue computors, supersonic wind-tunnels, electronic laboratory gear, harmonic analysers, cathode ray oscilloscopes and the kitchen stove and refrigerator (in larger and more highly-developed forms). But even then what finally matters is the team's attitude of mind towards its tools.

Our attitude at ENGLISH ELECTRIC is one of open-minded enquiry into what is a dauntingly big and complex problem. There are no tools we will not use—even if we have to invent them first—to find out all we have to find out; and there is no substitute for finding out. Before ever a new aeroplane flies, it must have been 'flown' on the ground until nothing that is knowable without test flying is left unknown.

This is a long and costly business—but today it is less long and far less costly than relying on a hunch and a hope.

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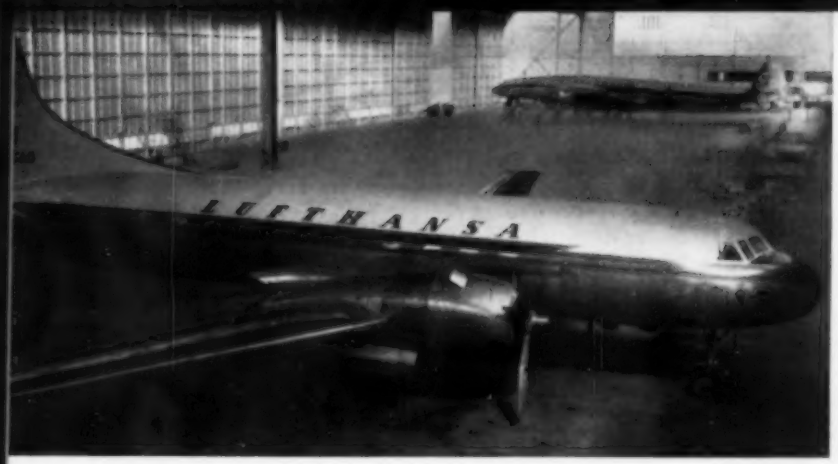



*A D.L.H. Convair 340 and Constellation L-1049G in the hangar at Hamburg.*

# DEUTSCHE LUFTHANSA IN SERVICE

## *How the Revived German Airline is Operating*

By JOHN STROUD

LAST Monday, May 16th, the new Deutsche Lufthansa began operation of international passenger services with the working in each direction of the Hamburg - Düsseldorf - London and Munich - Frankfurt - London services.

Leading up to this operation was a series of route-proving and training flights which began with a Hamburg - London journey on April 15th, when the Convair-Liner 340 D-ACAD made the first landing in the United Kingdom by a German civil-registered aeroplane for nearly 16 years. It was this same Convair which made another proving flight from Hamburg to London and back on May 4th and which gave me an opportunity of experiencing the new airline's methods of operation and seeing something of the Hamburg organization.

The aircraft, attractively finished with white cabin top, fin and rudder, and the blue and gold colours of Lufthansa, and bearing the black, red and gold German national colours on its fin, looked very smart as it stood in the sunshine close to one of the passenger ramps at London Airport Central.

Herr Joachim von Frankenberg, Lufthansa's London Airport manager, saw us aboard at 1422 hr, and we were welcomed over the cabin address system and given details of the flight plan before the Pratt and Whitney R-2800s were started at 1429. Four minutes later we taxied out and at 1442 were airborne and climbing steeply from runway 23R. Capt. S. J. Brown, one of the seconded B.E.A. captains, was in command with G. Wasserkampf in the right-hand seat. Stewardess Christa Kathke (once with B.E.A. on German internal services) and H. Wiegels comprised the cabin crew.

We passed over Croydon, to which the last Lufthansa service to Britain operated in the summer of 1939, and continued to somewhere around Canterbury, where we began our climb to 8,000ft. Lunch was served, Antwerp passed to our left, the Rhine came into view and at 1548 we touched down at Lohausen Airport, Düsseldorf, with engines off at 1600, to be received by friendly Lufthansa traffic staff, who guided us through Customs and passport control. We set off 28 min later for Hamburg, which was reached at 1730, with engines off at 1734. The flight of only 1 hr 6 min to Düsseldorf made the German light industrial area seem very close to London, and I was told that many people going to Hamburg and other further points, but who cannot afford to fly all the way, often fly from London to Düsseldorf, whence they continue by train.

On the following day I saw much of Lufthansa's main base which is at Fuhlsbüttel, the Hamburg Airport, although for political reasons the company's head office is in Cologne—at No. 1 Claudiusstrasse. When and if Germany becomes unified it is likely that the main base will be established at Berlin; and in that event the Hamburg base would become of secondary importance.

Herr Hans-Günter Deubel is the very able station manager at Hamburg and he is, perhaps, a typical example of the traffic staff of the new company. Previously he was with Pan American Airways and before that with American Overseas Airlines. His overall knowledge of air transport is extensive and his enthusiasm unlimited. I gathered that most of the traffic staff had gained considerable experience with other airlines operating through Germany, and all with whom I came in contact were determined to tell me how magnificently other lines had helped the company in its difficult task of establishing itself in an industry which is entirely different to that existing when the old Lufthansa ceased peacetime operations in 1939.

This vast change has perhaps been most felt in the operating side of the company. As is now well known, a number of B.E.A. captains are working with Lufthansa. They have been responsible for the training of the German pilots and for some time they will fly in command on all Lufthansa's European Convair flights. Many of the German pilots are ex-Lufthansa men, and at least one flew 1¼m km with the old company. But since these men last flew techniques have completely changed; they can no longer smell their way in the old faithful Ju 52s which could, if need arose, be put down almost anywhere; now they must conform to established traffic procedures, fly Airways, make procedure let-downs and operate aircraft which touch down at nearly 90 m.p.h.

Two Saab Safirs are used for training, and the instructional course consists of about 20 hr on these aircraft followed by 16 hr of instrument flying on a DC-3 and then a further 16 hr on Convairs. Eight German pilots have completed their courses and a further seven have just begun training.

Lufthansa is very conscious that it must provide the best possible cabin service and catering; and after flying with D.L.H. crews, meeting the catering manager, Herr Ernst Zobel, and learning something of the selection of staff and the training courses, I have the impression that the standards achieved will indeed be high. The courses for cabin crews are extensive and I was interested to learn that they are given some tough air experience. For instance, after about three weeks' ground training they are flown in a Convair by the Convair pilot who trained the B.E.A. captains to fly this type. On take-off one engine is stopped and the airscrew feathered just to show the trainees what happens; and then the full manœuvrability is demonstrated. So far it has been easier to find suitable girls than to get stewards, and most of the stewardesses so far engaged have been with other airlines.

Hamburg Airport at present handles about 200-250 movements a week and of these Lufthansa is looking after about 90, which include its own operations and those of Air France, Sabena, Swissair and Finnair. D.L.H. also handles Swissair at Düsseldorf and Munich, Iberia at Frankfurt and L.A.I. at Munich.

At Hamburg, D.L.H. has its own kitchens (with deep freeze) in which it prepares all its Convair meals for outward flights from Hamburg and also food for Finnair. The Convairs can carry only sufficient stocks for outward flights, so B.E.A. will supply meals ex-London, Air France ex-Paris and Iberia ex-Madrid.

The maintenance base consists of a new and well-lit hangar measuring 720ft in length and 164ft in depth. The door opening

(*Concluded on page* 704)

*The two Saab Safirs used for training, seen outside the D.L.H. hangar at Hamburg. One of the company's Convairs is beyond.*

# CORRESPONDENCE

*The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns; the names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.*

### Westland Record

THE recent Westland history by Mr. H. F. King will be retained by many readers as a valuable historical record, as indeed it is. For this very reason I would take up the author on a few small points, though first assuring him that I learned a great deal from his article, which included much hitherto unpublished information.

Mr. King rather dodged the issue of giving a name to the 32 Westland-built Short Seaplanes, referring only to the unofficial "225," bestowed by virtue of the 225 h.p. Sunbeam engine. These seaplanes were in fact twelve Short Type 184s (Nos. 8356-8367) and twenty Short Type 166s (Nos. 9751-9770).

The D.H.4 power units were quoted as B.H.P., Falcon and Eagle. This may have been the sequence of installations for production D.H.4s in general, but not for Westland-built models in particular. Rolls-Royce Eagles were not allotted to Westlands; their final production D.H.4s, starting at N6380, had the 200 h.p. R.A.F.3a fitted.

Westland's design staff were given the doubtful credit for the Walrus. The R.A.E. were in fact responsible for this adaptation of a D.H.9.A and Armstrong Whitworth were co-opted to produce the prototype, J6585. This machine was known as the Tadpole, a name almost as apt as Walrus in view of the appurtenances that seemed to grow on the aircraft. Production was then given to Westlands, who built 36 machines (N9500-9535).

Reference to the Wapiti Mk VI was left open. This aircraft was basically the Mk II constructed without the Scarff gun mounting and fitted with full dual control. In this way it differed from the Wapiti (T) which was a dual-control conversion of service Mk II and IIa Wapiti. Sixteen only Mk VI were built, Nos. K2236-2251.

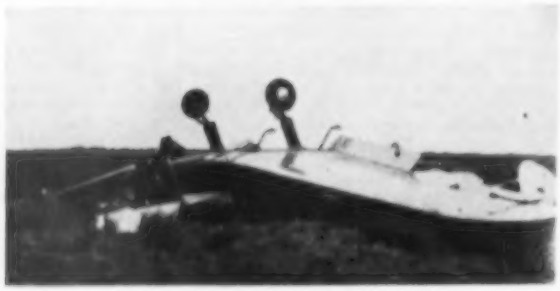
BRUCE ROBERTSON.

Sawston, Cambs.

### Non-starter

I WAS very amused to hear the announcement made by the commentator at the Swansea Air Races that the Cygnet had been "scratched." How right he was! (The enclosed photograph will give you all the explanations necessary.)

To be serious for a moment, I would like to explain that the Cygnet was equipped with Sutton harness, which always caused annoyance before taking off, and which I intended having removed and replaced with lap straps. When, due to engine failure while approaching the worst part of the Pennines, a forced landing had



*Mr. Lamprell's Cygnet after the "scratching."*

to be made on marshy ground, my companion and myself crawled out unhurt, although the cabin was completely crushed. I am confident that, had we used lap straps only, we would not have been so fortunate.

The aircraft was painted green and cream—green wings and under surfaces, and cream above—a thing I will never do again with another, for how difficult it would be to see from the air in bad country had a similar accident occurred. Bright colours every time!

Timperley, Cheshire. R. LAMPRELL.

### History and Secrecy

IN carrying out a certain amount of research just recently I have been rather concerned at the lack of tribute paid to the late J. W. Dunne and the lack of concrete information concerning his early experiments on behalf of the Balloon Factory from 1906 to 1909. S. F. Cody called his first aeroplane "British Army Aeroplane No. 1" but possibly the honour of this title belongs to a Dunne machine. (How about it, Mr. Broomfield?)

The security arrangements at the Factory and during the Blair Atholl tests in 1907 and 1908 have cast a fog over the history of this time; Dunne's D5 to D8, built after he left War Office employ, are reasonably well publicized, but with regard to the earlier, military aircraft (a) to the best of my knowledge no drawings or sketches have ever been published of Dunne aeroplanes D1 to D4, with the exception of the D2 as modified by Professor Huntingdon at Eastchurch in 1910; (b) two authorities—Jane's of 1911 (?) and *History of the R.A.E.* (1947) flatly contradict each other on which mark number belongs to which machine.

Dunne is dead; his pilot L. D. L. Gibbs is dead; is there a reader of *Flight* who *knows* what went on at Blair Atholl in 1907-08 and who is prepared to risk the Official Secrets Act? If so, let us hear from him.

Stanmore, Middlesex. SUBTYPE.

### Royal Air Force Bands

I AM truly amazed to read the letter by W. S. Whales in your edition of March 4th, and, in fairness to the Air Council, the Directors of Music, and all concerned, I beg leave to refute his statements and give the following facts:—

(a) The Central Band Staff have been training musicians to become band sergeants of voluntary bands since 1922. Many of my own pupils were promoted, and put in charge of such.

(b) An R.A.F. School of Music has been flourishing for some considerable time.

(c) Commanding officers on stations at home and abroad do everything possible to encourage music and musicians. Band-rooms are provided for practice; also, Air Ministry make special grants to voluntary bands.

(d) It would be quite impossible for any civilian to enter any Service "school of music."

Finally, the names of the R.A.F. directors of music, past, present, and their capabilities, need no enlarging upon. Suffice it to say, all have given more than 30 years' constant devotion to music as bandmasters, and this applies to the Director of Music, Cranwell, also. Through their combined efforts, the Central Band today holds the proud position of one of the finest musical organizations in this country—or indeed, in any country.

Heliopolis, Egypt. P. BEECHFIELD CARVER. (Bandmaster, ret.).

[Mr. Beechfield Carver, M.B.E., also adduces information which suggests that the writer of the original letter, in some of his assertions, was under a misapprehension.—Ed.]

## FORTHCOMING EVENTS

May 20. Institute of Navigation: "Automatic Dead Reckoning Instruments," by H. C. Pritchard.
May 21. S.L.A.E.: Annual general meeting. "The International and National Regulation of Airworthiness," by Sir Frederick Tymms, K.C.I.E., M.C., F.R.Ae.S.
May 21-23. Zoute Aviation Club: International rally.
May 27. Royal Aircraft Establishment: Senior Staff Mess Ball.
May 28-29. Fréjus St. Raphael Air Rally, France.
May 29-30. Aero Club of Ireland: Flying Display.
May 29-30. S.M.A.E.: British National Model Aircraft Championships, R.A.F. Station Waterbeach.
May 30. R.Ae.C.: Second National Air Races meeting (in conjunction with S.S.A.F.A. air display), Yeadon.
May 30. Royal Netherlands Aero Club: International Air Display: Ypenburg.
May 30. Women's Junior Air Corps: Air rally, White Waltham.
May 30-June 10. Canadian International Trade Fair and Air Show, Toronto.
June 1-11. Aluminium 1955 Exhibition: Royal Festival Hall, London.
June 1-11. British Plastics Exhibition and Convention: Olympia, London.
June 3-17. Aeronautical Union of Jugoslavia: Sixth Federal Gliding Contests, Jugoslavia.
June 4-5. Ninth Rally of the Wines and Chateaux Of Anjou, France.
June 4-5. Royal Air Forces Association: Annual Conference.
June 7-15. French Aero Club: F.A.I. 50th Anniversary Rally, Paris.
June 7-10. Institute of Transport: 1955 Congress, Southport.
June 10-19. Paris Aero Show.
June 11. R.Ae.C.: Third National Air Races meeting, Bristol.
June 11. Royal Air Forces Association: Air Display, R.N.A.S. Sydenham, Belfast.
June 11. Aircraft Golfing Society: Match v. Racing Club de Paris, La Boulie, Paris.
June 17-24. F.A.I.: General conference.
June 18. R.N.A.S. Eglinton, Northern Ireland: Air Day.
June 18. R.N. Electrical School, H.M.S. "Ariel," Worthy Down, Winchester: Air Day.
June 20-July 1. I.A.S. and R.Ae.S.: Fifth Anglo-American Aeronautical Conference, Los Angeles.

# The POWER of Armstrong Siddeley

Fitted with two Armstrong Siddeley Viper turbojets and a S.E.P.R. liquid fuel rocket the French SNCASO Trident has broken through the sound barrier in a climb — the Viper is the first British engine to do so. The 'mixed power plant formula' is the next logical step in intercepter technique — the jet engines are used for substained economical cruising, the rocket supplies the extra boost required to give the aircraft the very high rate of climb necessary for the interception of high speed jet bombers at very high altitudes. This is the first time that a British engine has been used for 'mixed power plant formula' — a further achievement of the power of Armstrong Siddeley.

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**F-R Float Switch**

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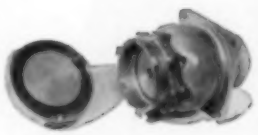

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# AT THE B.I.F.

## *Materials, Tools and Equipment at Castle Bromwich*

FIRMS well known in the aircraft industry were, as usual, represented in force in the engineering section—at Castle Bromwich, Birmingham—of the British Industries Fair, which concluded last Friday. Also as usual, essentially aeronautical items were in general absent from the stands of these firms; nevertheless, suppliers of materials and tools, at least, were displaying much the same sort of products as may be seen each year in the static show at Farnborough.

Thus Desoutter Brothers, Ltd., had an impressive display (backed by stable doors from which the "little horses" peered) of their power tools, a special point being made, and demonstrations given, of the new rack-feed drill described in *Flight* of October 15th, 1954. Wolf Electric Tools, Ltd., were another firm with an impressive display of equipment in this field. Jenks Brothers, Ltd., showed extensive ranges of wrenches and other engineers' hand tools, and we were particularly impressed by some large multi-drawer tool-chests fitted with almost every conceivable type of mechanics' tool; these kits, we were told, were in very great demand for use in isolated areas of the Commonwealth. Another well-known maker of hand tools (together with jigs, fixtures, press tools and measuring equipment) represented at the Fair was the Leytonstone Jig and Tool Co., Ltd.

Among the materials manufacturers, I.C.I. Metals, Ltd., had this year considerably increased the extent of their titanium display. They showed, in addition to ingots of various sizes, a selection of small fabricated parts.

One of the stands displaying non-metallic materials was that of Bakelite, Ltd., whose exhibit included a Gloster leading-edge jig in Fibreglass laminate, the bushes and locators moulded in position with Bakelite polyester resin. On the stand of Hordern Richmond, Ltd., "Hydulignum" press tools, as now widely used in the aircraft industry, were being demonstrated on a small power-press.

Garringtons, Ltd., were again in the Show, exhibiting hand tools and forgings; in the latter connection they are suppliers of gas turbine blades, forged by the upsetting process, on a very large scale.

On two stands, in the hardware and electrical sections respectively, Joseph Sankey and Sons, Ltd., had exhibits which gave some idea of their versatility in sheet metal work—exemplified in the aircraft industry by, in particular, gas turbine assemblies. The Saunders Valve Co., Ltd., were as usual represented, the well-known spherical plug cock being recognizable among the various valves and other fittings on view. On the Teddington Group's stand, Teddington Aircraft Controls, Ltd., had a display covering hot air valves with actuators, altitude switches, magnetic amplifiers, a 1½in butterfly valve, an inching control, and a solenoid-operated gate valve.

Herbert Terry and Sons, Ltd., showed, in addition to their "Security" hose clips (and, of course, a positively formidable array of springs) a new type of "Anglepoise" lamp fitted with a miniature bulb and shade particularly suitable for use in confined spaces, e.g., on machine tools. On the stand of George Salter and Co., Ltd., springs of almost every variety shared space with roller bearings of various types and grey iron castings.

B. Attewell and Sons, Ltd., were featuring "R.L.A." laminated aluminium sheet and shims for which they are sole distributors—an ingenious method by which packings may be adjusted by increments of 0.002in or 0.003in simply by peeling off a lamination.

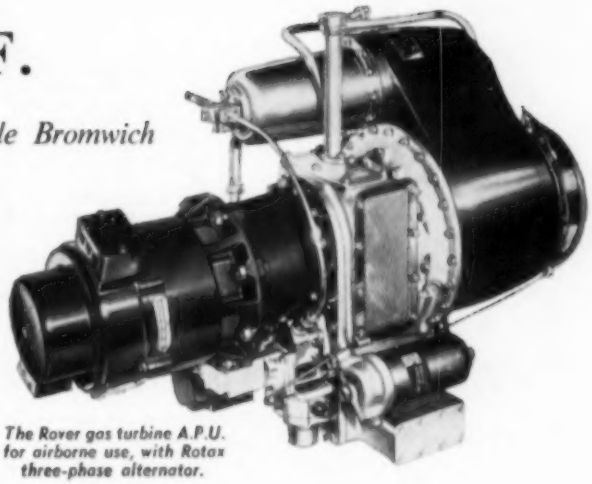
The Sandwell Casting Co., are specialists in non-ferrous castings and we learned on their stand that they are doing precision work in this field for a number of aircraft and engine manufacturers, their products finding a place in the Hunter, Swift and Viscount; service rings used in broaching operations on gas turbine parts are another of their products.

Autoset (Production), Ltd., again had on view their extraordinarily wide (both in size and design) range of industrial castors, together with materials-handling equipment based on these useful components.

New Welbeck, Ltd., makers of the industrial vacuum cleaners referred to in *Flight* of February 25th this year, had on their stand an entertaining "eye-catcher" in the form of rubber balls kept in mid-air—shooting-gallery fashion—by the exhaust streams from a variety of their machines.

L. H. Newton and Co., Ltd., A.I.D.-approved makers of precision-turned parts, were showing samples of their work, which includes specially high quality bolts and similar parts for the aircraft industry.

On the G.E.C. stand was a remarkable contrast: alongside such essentially domestic items as refrigerators and electric irons were a model guided weapon and examples of electronic guidance systems now being made by the company. There was also a display showing the use of electronic apparatus for simulation, enabling complete airborne equipment to be developed and evaluated in the laboratory.



*The Rover gas turbine A.P.U. for airborne use, with Rotax three-phase alternator.*

The Heston Aircraft Co., Ltd.—well known in pre-war days as manufacturers of Heston Phoenix—had a share in the stand of the Heston Group (whose companies make a wide range of engineering equipment); they are now making aircraft passenger steps and maintenance docks, and have recently installed a dock for B.E.A. at London Airport. Another familiar name to be found on a Castle Bromwich stand was that of Boulton Paul Aircraft, who are doing a very considerable business in the production of industrial measuring instruments in the electronic, electro-mechanical and other fields.

On the stand of Marston Excelsior, Ltd.—an I.C.I. subsidiary—were examples of aluminium alloy pipe work, fabrications and pressings, and complete assemblies such as the heat-exchangers for which the firm are well known.

Plastic Engineers, Ltd., were showing a variety of gears and other precision engineering components machined from nylon; their products include the nylon inserts for a well-known make of locknuts, and valve seatings used in cabin pressurization equipment. Locknuts components figured also in the display of Walsall Pressings, Ltd., who produce anchor cages for such nuts in hundreds of thousands; they also do many varieties of presswork, making a speciality of "tricky" jobs to fine limits. Guest, Keen and Nettlefolds (Midlands), Ltd., had their usual large stand in the Show; they are particularly well known in aviation for their "Aerotight" stiffnuts.

Though industrial and domestic finishes, rather than aircraft products, were featured in each case, the names of Cellon, Ltd., and Docker Brothers sounded a familiar note.

Lansing Bagnall, Ltd., were demonstrating their materials-handling equipment, including the new S.F.R. 225 reach-fork truck—on a stand arranged with narrow passage ways, corners and an inclined ramp to simulate industrial conditions.

Vernons Industries, Ltd., are makers of electrical generating sets, including ground starting equipment, and on their stand we learned of an ingenious new development: an aircraft ground-handling unit, built to M.o.S. order. Very briefly, it consists of a three-wheeled electrically-driven tractor, between the two rear wheels of which is a semi-circular channel-section girder, positioned parallel with the ground and a few inches above it. The channel is lowered to ground level and pushed under the aircraft tailwheel or nosewheel; the channel is then raised, whereupon the aircraft can be towed away at any required angle. The device would be particularly useful in the event of a damaged nosewheel or tailwheel.

Attracting a great deal of attention among the outdoor exhibits was a Rover gas turbine auxiliary power unit, which was being demonstrated coupled to a Sigmund fire pump delivering 500 gallons of water per minute at 100 lb/sq in; another installation, arranged by Petbow, Ltd., was a self-contained A.P.U. with Rover gas turbine and B.T.H. alternator; and a third installation was a Rotax system, weighing 195 lb, particularly suitable for airborne applications such as de-icing and heating. Attention was also drawn to the new instructional set, consisting of gas turbine, Heenan and Froude dynamometer, air meter with associated ducting, and efflux pipe with thermocouple adaptors. The instru-

## AT THE B.I.F. . . .

mentation is mounted on a control desk, and from it a wide variety of performance data can be plotted and explained.

Also out-of-doors, Hampson's Industries, Ltd., were showing a 10 kW ground servicing unit as supplied by them to the Air Ministry; they are making, too, 18 kW units for the U.S. Air Force. Thomas Adshead and Son, Ltd., were demonstrating their mobile hydraulic platforms, of the type described in *Flight* of May 6th this year.

Among other regular exhibitors at Castle Bromwich were W. H. Paul, Ltd., who, though their exhibits here were mainly of a domestic variety, in fact do a considerable amount of gas turbine sheet-metal work; Rotherham and Sons, Ltd., well known for caps, unions, repetition parts, instruments and instrument components; the Rubery Owen Organization, suppliers of—among many other things—aircraft materials, fittings and sub-assemblies; and British Aero Components, Ltd., whose display featured drill jig bushes and comparable parts. The Bristol Aeroplane Co., Ltd., figured on the stand of the Bristol Engineering Manufacturers' Association, showing a very fine sectioned Proteus engine; and Rolls-Royce, Ltd., on the "Derby for Industry" stand, had a sectioned Derwent.

Among other firms represented at the Castle Bromwich section of the B.I.F. were the following:—

Aldis Brothers, Ltd.; George Angus and Co., Ltd.; B. B. Chemical Co., Ltd.; British Ermeto Corporation, Ltd.; British Resin Products, Ltd.; Clang, Ltd.; Conveyancer Fork Trucks, Ltd.; Dunlop Rubber Co., Ltd.; E.M.I. Electronics, Ltd.; English Electric Co., Ltd.; English Steel Corporation, Ltd.; Essex Aero, Ltd.; Samuel Fox and Co., Ltd.; M.C.L. and Repetition, Ltd.; Exors. of James Mills, Ltd.; B. O. Morris, Ltd.; David Moseley and Sons, Ltd.; Newton Brothers (Derby), Ltd.; Precision Metal Spinnings (Stratford-on-Avon), Ltd.; J. B. Purefoy Unit Tooling, Ltd.; Radiovisor Parent, Ltd.; Revo Electric Co., Ltd.; Sciaky Electric Welding Machines, Ltd.; Serck Tubes, Ltd.; Shell-Mex and B.P., Ltd.; Thompson Brothers (Bilston), Ltd.; Tufnol, Ltd.; Westinghouse Brake and Signal Co., Ltd.; Wrights' Ropes, Ltd.; Yorkshire Copper Works, Ltd.

# THE INDUSTRY

### Rotol-Messier Apprentices Rewarded

AT the annual apprentice prize-giving of Rotol, Ltd., and British Messier, Ltd., the prizes were presented by Lt-Gen. Sir Ronald Weeks, chairman of Vickers, Ltd. In company with two other directors of Vickers companies, Maj. Gen. Dunphie and Mr. G. R. Edwards, he flew from Weybridge in an executive Heron, but bad weather prevented the aircraft from reaching Staverton and the party had to land at South Marston and complete their journey by road. Two directors of the Bristol Aeroplane Co., Ltd. (and also of Rotol, Ltd.), Sir Reginald Verdon Smith and A. Cdre. F. R. Banks, flew over from Filton in a Bristol 173 helicopter.

Sir Ronald was introduced by the managing director of Rotol, Ltd., Lt-Gen. Sir John Evetts, who also welcomed the visitors from Weybridge and the principals of North Gloucestershire Technical College, Forest of Dean Technical College and other officials of educational establishments in the area. Sir John said that the company's apprentice scheme was only 16 years old, yet by the end of 1955 268 completed apprenticeships would have been recorded.

In his speech, Sir Ronald Weeks said that he was glad to have the opportunity of acknowledging the work which Rotol and British Messier had been able to do, and were doing, for the Vickers organization. Addressing the apprentices, he referred to "what long-sighted management is trying to do for your benefit" and said it was up to each one of them to take full advantage of what was provided. The prizewinners were as follows:—

**Higher National Certificate.**—*Mechanical Engineering:* N. H. Evans (David Richardson Prize), D. G. Edden, N. W. Chambers, K. A. Mason, C. G. Walker. *Production Engineering:* A. G. Hutcheon, M. G. Wren, L. E. Kelly.

**Ordinary National Certificate.**—M. J. Blenche, T. K. White, J. B. Davies, B. H. Shill, D. J. Dowding, P. J. Joyner, Miss P. Bailey, Mrs. Digby-Worsley.

**City and Guilds Machine Shop Engineering.**—*Intermediate Certificate:* J. E. Hemsley, K. G. Ackrill. *A1 Stage Mechanical Engineering:* C. Q. Hall. *A1 Stage Production Engineering:* H. H. Canty, M. Hawker. *S2 Stage O.N.C.:* J. R. Boulton, D. H. Nichols. *S1 Stage O.N.C.:* J. R. Flight, G. H. Wilson.

When the Queen and the Duke of Edinburgh paid their visit to the City of Gloucester's recent centenary celebrations they saw an exhibition of local industries, and a display by Rotol, Ltd., was one of the exhibits in which they took a particular interest.

*A member of the fair sex receiving an award at an apprentice prize-giving makes an unusual picture. Two were among Ordinary National Certificate recipients at the Rotol presentation (see above). Mrs. Digby-Worsley receives her prize from Lt-Gen. Sir Ronald Weeks.*

### Ground Power for NATO

IT has only recently become possible to publish some details concerning the ground power units—or "energizers," as the U.S.A.F. call them—being supplied by Auto Diesels, Ltd., for the starting of jet aircraft used by NATO air forces.

Power is provided by a Rolls-Royce B.60 engine, stated to have been the only type which completely met the severe specification stipulated. Closely governed to 3,000 r.p.m., it develops 86 b.h.p. and is flexibly coupled to a special Crompton Parkinson d.c. generator with a direct-coupled exciter. The continuous output is 22kW at 28.5 volts (770 amp.) with an intermittent rating of 185 per cent full load current (1,425 amp.) for one minute. Servicing and starting loads are possible at constant voltage supply; alternatively, constant current or current limitation control can be selected to cater for the varied types of aircraft with which the unit is likely to be used.

Current limitations can be effected at selected values of 800, 1,000, 1,200 and 1,400 amp. When the unit is operated under constant voltage control the voltage is held constant at the end of the supply cables and at the aircraft terminals regardless of load current variations. Separate service and starting outputs are available as required. Normal overload, over-voltage and reverse current protection is provided.

The whole equipment is mounted on a trolley and is weather-proofed. Pre-production models were subjected to extensive endurance and environmental tests, including cold- and hot-start operation, rain, salt water and humidity tests.

Auto Diesels, Ltd., of Uxbridge, Middlesex, co-operate with Crompton Parkinson, Ltd., in the manufacture of these units and the entire range is marketed under the name of Crompton Parkinson-Auto Diesels.

# IN BRIEF

Mr. C. E. D. Catley has recently travelled to Canada in order to superintend the setting up of a pilot plant for the manufacture of Hellermann sleeves, cable markers and other products. A new company, Hellermann (Canada), Ltd., is in course of formation.

* * *

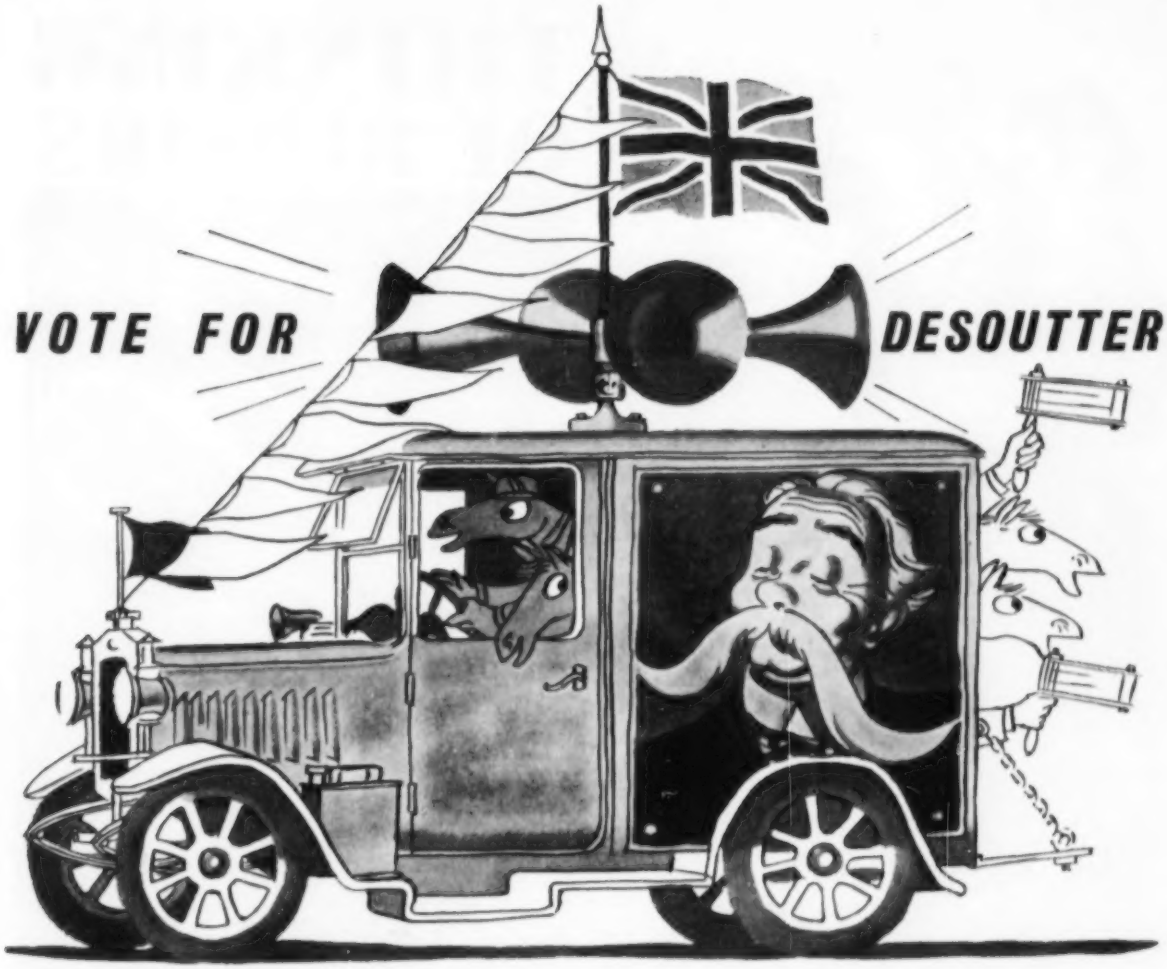
B. Attewell and Sons, Ltd., makers of "R.L.A." laminated aluminium shim material (A.I.D. and A.R.B. approved) have moved into a new factory, Reflection Works, Thorney Lane North, Iver, Bucks (Iver 1103-3; telegrams, Reflection, Iver). The company are also well known as makers of press tools, jigs and fixtures and plastic components. Reference to their exhibit at the B.I.F. is made on the previous page.

* * *

Fairey Aviation Co. (Canada), Ltd., has opened a Western Canadian works at Pat Bay Airport, Victoria, and has already secured contracts for repair and maintenance of Naval and civil aircraft. The managing director, Mr. C. E. Hibbert, has said that he expects to employ 100 men within a year. The company's main base is at Halifax, where 1,000 are employed.

* * *

Recent aircraft standards published by the British Standards Institution include B.S.G. 148, *Platinum Wire Thermometer Bulbs and Connectors for Aircraft* (price 2s); B.S.G. 149, *Nickel Wire Thermometer Bulbs and Connectors for Liquid Temperature Measurement in Aircraft* (2s); and B.S.M. 24, *Graphical Symbols for Aircraft Hydraulic and Pneumatic Systems* (3s 6d). These standards are obtainable at the prices named from the British Standards Institution, Sales Branch, 2 Park Street, London, W.1.




**Don't be so Conservative—** *just because your father and grandfather before him bored holes with a gimlet is that any reason why . . . (and so on and so on)*

**Down with Labour—** *was man born to be a beast of burden? Very likely, but that is no reason why he should . . . (and so on and so on)*

**Ladies and Gentlemen, only one issue lies before you.**
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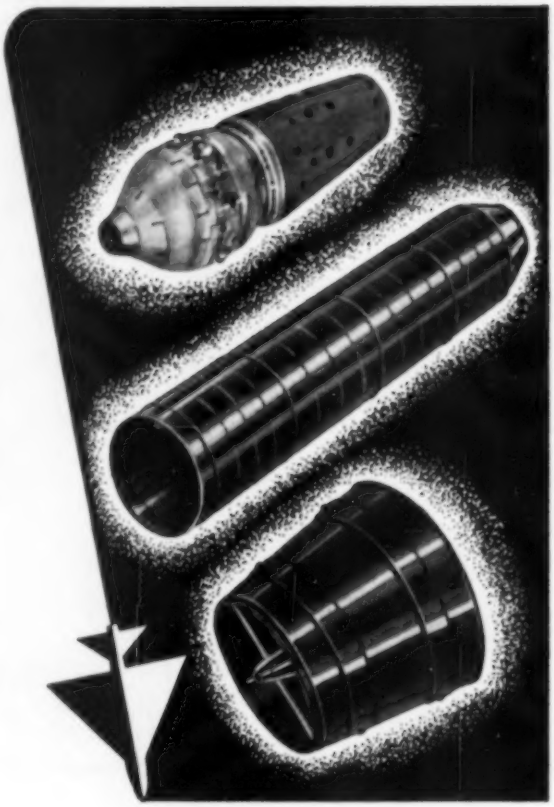

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*Civil Aviation*

# DECCA EVALUATED

## *Findings of the 1951-53 M.T.C.A. Trials—and a Decca Postscript*

ISSUED recently by the Ministry of Transport and Civil Aviation, *An Evaluation of the Decca Navigator System* is nothing if not comprehensive. It covers—in 298 pages of words, photographs, charts, drawings, diagrams and tables—an extensive programme of study and trials made during 1951, 1952 and 1953. This programme was itself the outcome of a recommendation by the Communications Division of I.C.A.O.

The report was prepared by the Civil Aviation Navigational Services Group of the Ministry (R. L. Gillham; A. Coates, M.A.; F. Kitchen, B.Sc.; G. H. Trow, D.F.C.; D. D. Lipman, D.F.C.; H. Keeling; and E. Jenkins, D.F.C., D.F.M.). Its subject is a controversial one, and it may be that some of its findings will be questioned both by protagonists and by opponents of the Decca system. The only cause for complaint by the neutral observer, however, appears to be the length of the interval between conclusion of the trials and publication of the report. As might be expected, certain changes have been made in the Decca equipment during that period, and these changes are described in the Decca company's official comment on the M.T.C.A. report. Both report and comment are briefly summarized below.

The Ministry's evaluation begins with a technical description of the Decca system, in which basic principles, ground equipment and airborne equipment are described in detail. The various factors which influence the performance of the system in practice, and so cause departures from the theoretically postulated performance, are next discussed. Examples of such factors are phenomena associated with the propagation of low-frequency radio waves and the effects of radio-frequency noise on the operation of the system.

The operational part of the report begins by describing each phase of the flight-trials programme, in which the standard of E.T.A.-keeping, track-keeping, ease and accuracy of flying terminal-area procedures, and other performance characteristics of various items of Decca equipment were examined. The last two sections of the evaluation give the M.T.C.A. conclusions on the operational capabilities and limitations of the system, and an assessment of the extent to which the system meets the functional requirements of a short-range navigation aid.

Among the conclusions quoted in the evaluation are the following:—

"**Cover:** The ultimate range of a chain is governed by the effects of errors introduced by skywaves, but within this limitation the useful cover naturally depends upon the operational use to be made of the system. Although a chain is usable at a range of at least 250 n.m. from its Master station at night, and at ranges well in excess of this in the superior conditions of daytime, a further limitation must be applied if very high reliability is required when the system is used as an aid to Air Traffic Control. The cover given by a chain should then be considered as being limited to the reliable range of lane identification, and at night this also happens to coincide broadly with the range beyond which accuracy and Flight Log chart scales deteriorate (150-200 n.m.) for the more elaborate uses of the system. Cover has been checked up to 30-40,000ft during trials.

"**Operational accuracy:** The basic accuracy of the system in the air has been found to be better than that predicted for ground level, and the improvement may be of the order of 20 per cent.

"The 95 per cent operational accuracy of track-keeping with the Flight Log at various ranges from the Master station of a typical Decca chain when in front cover, using optimum chart scales, under night conditions, and following the worst direction of tracking in relation to basic accuracy is:—

±1 n.m. at 120 n.m. range
±2 n.m. at 200 n.m. range
±3 n.m. at 250 n.m. range

In all other directions of tracking considerably better accuracy can be achieved by night, and the accuracy is greatly improved in all tracking directions by day, particularly at the longer ranges.

"The 95 per cent accuracy of E.T.A.-keeping with the Flight Log, even for a slow aircraft operating at night at a range of up to about 200 n.m. from the Master station of a Decca chain, is better than:—

(a) ±3 minutes when no attempt is made to meet E.T.A. by adjustment of airspeed, and

(b) ±2 minutes when the pilot attempts to meet E.T.A. by adjustment of airspeed within a range of ±10 per cent,

provided the change in wind component along track is less than 10 per cent of the ground speed on 95 per cent of occasions.

"**Use as an aid to Air Traffic Control:** Improved utilization of airspaces and aerodromes may be achieved by use of the Flight Log, as follows:—

(1) Up to approximately 200 n.m.

(a) Ensuring that an aircraft stays within an airway 10 n.m. wide.

(b) Reducing present longitudinal separation standards significantly.

(c) Descent through cloud.

(d) Holding an aircraft continuously within 8 n.m. of a desired point.

(2) Up to approximately 150 n.m.

(a) Parallel track flying within an airway 10 n.m. wide.

(b) Aerodrome approach and feeding on to a runway approach aid to facilitate 'straight in' approaches.

(c) Holding an aircraft continuously within 4 n.m. of a desired point in such a manner that the pilot knows his position in the holding pattern at all times.

(d) Sequencing aircraft for rapid landings, nominally at 3 minute intervals, when used with an aid to approach and landing, without requiring detailed guidance from Air Traffic Control.

"**Frequency problems:** The problems likely to arise in frequency planning fall into two main categories:—

"(1) The number of frequencies required to cover a given area or air route is obviously dependent upon the area or route cover to be expected in practice from one chain. The evaluation shows that the reliable range of a chain may be 150-200 n.m. when using Decca for Air Traffic Control purposes at night, and therefore more frequencies may be required than were originally estimated.

"(2) The second consideration is that of the range at which it is possible to repeat frequencies, and, although theoretical considerations show this range to be of the order of approximately 1,500 n.m., no practical confirmation is so far available.

"**Serviceability:** Serviceability of Decca chains has attained a very high standard. Several types of airborne equipment have been used during the course of the evaluation. Various models of receiver and Flight Log have been used, and changes in aerial systems and equipment layout have been made. However, the trials have been chiefly carried out using prototype equipment and serviceability has not reached the high level to be expected from production models.

"**Vulnerability to precipitation static:** Theoretical evaluation indicates that with the latest equipment, properly designed and positioned aerials, and satisfactory installations, reliability should not be greatly affected by precipitation static. However, in the series of trials for this evaluation, it has not been possible to confirm theoretical estimates of the degree of reliability, and it may well be that full evidence on this problem can only be obtained after the system has been in use by air operators for a considerable period.

"**Terrain effects:** During tests carried out for this evaluation, terrain effects within the normal system coverage did not appear to affect reliability and contributed little to errors of the system.

"**Performance in high-speed, high-altitude aircraft and in helicopters:** Tests have been carried out using Decca in aircraft flying at ground speeds of 400 kt, and altitudes of between 30,000 and 40,000ft, and also in helicopters flying at very low altitudes. No undue difficulties have been encountered, and the tests showed that the Decca system was quite satisfactory for these operations.

"**Operation of the equipment:** The trials for this evaluation have shown that manipulation in the air of the latest type of receiver and Flight Log can be accomplished without undue difficulty, under normal conditions, once a certain degree of skill has been acquired.

"**Extent to which the system meets the functional requirements of a short-range navigation aid:** The Decca system almost completely meets the functional requirements in providing the accuracy needed for optimum longitudinal and lateral separation of aircraft and maximum utilization of airspace; in providing cover

## CIVIL AVIATION . . .

at all operationally used altitudes; in the type of information available to allow flexibility in routing which again leads to optimum utilization of airspace; and in the form of presentation of information for direct application to the handling of the aircraft. It is in these aspects that the marked superiority of Decca . . . lies.

"In the degree of reliability available, in the provision of a partial ground service, and in certain aspects of instrumentation and equipment layout the Decca system cannot be considered to meet the ideal requirement quite so completely. Nevertheless, by the use of certain checking features and by taking certain precautions with regard to the aerial installation, a relatively high degree of reliability can be achieved under all conditions up to 200 n.m. range from the Master station."

**Decca Company Comment.** The Decca receiver used in the Ministry's evaluation was of the Mark 7 type. The Decca company's official comment on the report refers to the increase in the number of operational users of the system during the two years since the evaluation was completed, and describes the improvements in equipment and techniques made as a result of this experience. In particular, the new Mark 10 receiver is described. "The laboratory research (for the improved techniques)," the company states, "is already completed and the modifications necessary to ground and airborne equipment can be realized in operational practice throughout Decca coverage in one to two years from now."

Concerning the performance of the Decca equipment in static, the company mentions "improvements in the notch-holding circuits of the Mark 7 which allow breaks in the master signal for up to 30 sec—as opposed to the much shorter time possible with the equipment used in 1953—without loss of notch." A new "shovel-type" anti-static aerial had also been designed which, if positioned correctly, resulted in the receiver being unaffected by the heaviest precipitation static. The Night Postal Service DC-3s of Air France (the statement continued) which had been using the new aerials for the last 18 months, had had no case of loss of Decca information even when flying for prolonged periods in the very heaviest forms of rain and hail static.

In the M.T.C.A. assessment of Decca equipment against the functional requirements of a short-range navigational aid, the two main criticisms are (a) limitation of the coverage area in some cases by the range of satisfactory lane-identification, and (b) complexity of manipulating the equipment, especially that involved in initial setting up, chart change, re-referencing following chain change; checking decometers against lane identification and checking the Flight Log against decometer readings. Research by the company towards overcoming these disadvantages, the statement continues, had resulted in the design of the Mark 10 receiver and its associated ground station improvements.

This receiver had the following characteristics:—

"(a) It employs the superheterodyne principle which enables a single receiver to work on 17 different frequencies within the Decca navigational band" (compared with 9 in the Mark 7).

"(b) It provides automatic lane identification which sets the decometer needle to the correct lane number, if necessary once per minute, without the intervention of the user. The lane identification so achieved is always positive and correct to about the range of decometer integration, i.e., 240 nautical miles from the Master station at night. The system is fail-safe in that erroneous indications cannot be given.

"(c) Zone identification, which reduces by a factor of 5 the residual ambiguities of the present system, is also provided automatically, thus simplifying setting-up procedures.

"(d) The Flight Log associated with this receiver will embody similar automatic setting facilities which will further simplify manipulation."

After listing the technical features of the Mark 10 equipment (we hope to print a full description in an early issue) the company's comment concludes: "With new computers, designed on a more compact scale for the Flight Log, the complete Mark 10 installation will not exceed in bulk and weight the present Mark 7 Decca equipment. . . .

"It will be noted that Mark 10 Decca preserves the accuracy of the continuous-wave phase-comparison techniques, which have always been the basis of the system's success, with the advantages of automatically exploited low residual ambiguity, which have hitherto been regarded as the prerogative of pulse systems. It should be emphasized, however, that these advantages are introduced in Mark 10 Decca with the addition of only one more spot frequency and this should render the improved system by far the most economical from a frequency bandpass point of view. Mark 10 Decca uses pulse techniques, but the pulses are generated in the users' receivers and only employ the limited number of harmonics required for the phase-comparison functions of the receiver.

"Laboratory research is completed and with the encouragement of air users and Civil Aviation authorities generally, it is planned to complete the development of the equipment for a full scale operational trial on a chain of stations in the United Kingdom in the very near future."

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# South Bank Trials

THE regular B.E.A. passenger helicopter service between London Airport and the South Bank site is expected to begin next month. In preparation for this, a series of take-off and route trials have been made during the past fortnight by the Corporation, using G-ANUK, its second Westland-Sikorsky WS-55, fitted with metal floats and a Vokes silencer.

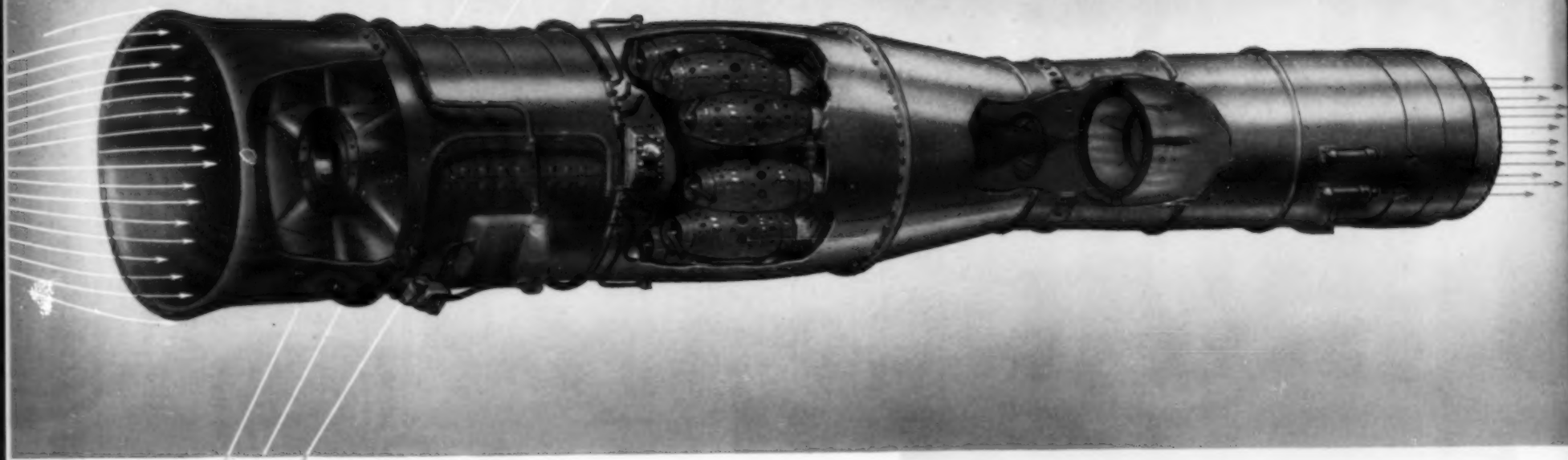
The first part of the tests involved a series of measured take-offs from the South Bank site, under various wind conditions. By means of theodolites, reference posts and a ciné camera, the take-off and approach angles at various weights, and using various techniques, were recorded. Subsequent analysis was to provide data not only on WS-55 take-off weights and performance, but also on the approach and take-off procedures to be used when regular South Bank services begin. Maximum authorized take-off weight is 7,500 lb.

The second series of tests was concerned mainly with familiarization flying over the route between the South Bank site and London Airport. Four B.E.A. helicopter pilots, with Capt. "Jock" Cameron in charge, were engaged on the trials, together with a number of project engineers and flight operations personnel of B.E.A., and M.T.C.A. representatives.

"Flight" photographs

*Distinctive if ungainly in appearance, G-ANUK has been used for trials from the South Bank over the past fortnight. Left, County Hall to one side, and a scaffolded Big Ben across the river.*

# *Specialists in Gas Turbine Combustion Components*



**BRIGGS MOTOR BODIES LIMITED**

**SWAYTHLING, SOUTHAMPTON**

HEAD OFFICE: DAGENHAM, ESSEX.

**The illustration shows a typical Aircraft Gas Turbine Engine. The parts shown in red and grey, comprising:**

**Flame Tubes, Combustion Chamber Outer Casing, Exhaust Unit, Reheat Jet Pipe Assembly**

**are manufactured at our Works at Southampton.**

**We also manufacture the following major units:**

- **Front Nozzle Box Panels**
- **Discharge Nozzles**
- **Cooling Air Manifolds**
- **Annular Combustion Chambers (complete)**
- **Combustion Chamber Heat Shrouds**
- **Stator Conical Supports**
- **Outlet Branch Extension Units**
- **Bearing Housing Units**
- **Bearing Cover Units**
- **Fire Wall Units**
- **Oil Tank Units**
- **Jet Pipe Assemblies**

*Flight*, 20 May 1955

*Problems of flight*

# WING FLAPS

Tiny extemporised runways, heavy loads — this combination is often imposed by modern business and modern war. To deal with it man has devised aircraft with very slow stalling speeds, achieved by means of leading-edge slats and trailing-edge flaps. Nature, in large cliff-dwelling birds like the gannet, long ago faced the same problem — and found the same answers. The gannet's

six-foot wing-span gives it nearly 50 m.p.h. in still air. But it nests in remote, craggy, far-northern cliffs, in crowded colonies of up to 10,000 pairs. This means that with all its size, weight and speed it must land on a sixpence. When it comes in to land — upwind whenever possible — it spreads its tail and large webbed feet wide to act as airbrakes. At the same time the secondary wing-feathers are pressed down, forming a broad flap at the trailing edge. The bird loses flying speed sharply. At this point a tuft of feathers — the alula or "bastard plume" — is extended from the leading edge. It has exactly the same effect on stalling characteristics as the leading-edge slats of an aircraft: at low flying-speeds it controls the airflow over the

aerofoil at a large angle of attack, and so delays the moment of stall until the bird is practically motionless.

Precisely the same method makes possible the astonishingly low stalling speed — 38 m.p.h. — of the Prestwick Pioneer, which can land in as little as 50 yards, and it is now being applied also to a 16-passenger twin engined version of the Pioneer. So man has solved yet another of his aeronautical problems with a technique that Nature has used for countless ages.

Pilots who land on airfields both large and small all over Britain value the excellent and helpful service of the Shell and BP Aviation Service.

## SHELL and BP AVIATION SERVICE

*Shell-Mex and B.P. Ltd., Shell-Mex House, Strand, London, W.C.2.*

*Distributors in the United Kingdom for the Shell, BP and Eagle Groups.*

Copies of this advertisement can be obtained from Shell-Mex House.

## CIVIL AVIATION . . .

### CONTINENTAL AIRLINES: VISCOUNT OPTION

MANY leading figures in British aviation attended a reception held in London last week by the Shell companies to honour four executives of Continental Airlines—Mr. Robert F. Six, president; Mr. O. R. Haueter, vice-president operations, maintenance and engineering; Mr. Don Wilson, assistant to vice-president of operations; and Mr. R. G. Schorling, director of purchasing and property.

The primary purpose of their visit to England was to discuss a possible order for 15 Viscounts; it is understood that, if ordered, the aircraft will be delivered in 1957. The executives have implied that no order would be placed until after their return to the company's headquarters at Denver, Colorado, where they will further study in detail the performance and delivery data supplied by Vickers.

Meanwhile, Mr. Six has signed an option on a number of aircraft to secure for Continental a place in the steadily growing queue for Viscounts.

### HUNTING-CLAN'S VISCOUNT FLAGSHIP

THE first British independent operator to order Viscounts, Hunting-Clan Air Transport, took delivery of their flagship, G-ANRR, at London Airport on May 12th. The company lost no time in putting the aircraft to work; it left the same day for tropical and altitude trials in Africa. Aboard were H.C.A.'s managing director, Mr. M. H. Curtis, and technical manager, Capt. L. B. Greensted, and a number of crew personnel, together with representatives of Vickers-Armstrongs, Rolls-Royce, Rotol and Goodyear. The itinerary for the African tour, which will include crew training as well as trials, is Nice, Malta, Beirut, Khartoum, Entebbe, Nairobi and Salisbury.

G-ANRR differs in several respects from previous Viscounts. It accommodates more passengers than the standard version, having 53 rearward-facing seats; though the interior is thus of high-density layout it includes two toilets, a bar and a galley. Power units are four Dart 506s driving new paddle-blade Rotol airscrews and giving a cruising speed of 320 m.p.h. Maximum take-off weight is 60,000 lb. The aircraft has provision for fitment of slipper tanks, increasing the maximum range to 1,900 miles. Hunting-Clan will take delivery of their next two Viscounts during June and July and the fleet will be completed by the delivery of a further two in 1956.

The decision to send the first H.C.A. Viscount to Africa for trials does not imply any change in the company's plans to introduce the new aircraft on its northern network (the first Viscount service from Newcastle is scheduled for June 17th). Ultimately, however, it is possible that the type will see service on Hunting-Clan's colonial coach routes to Africa. Both Airwork and Central African Airways, who also operate on this route with Vikings, have Viscounts on order.

### ATLANTIC FREIGHT BOOM

ADDITIONAL demand for transatlantic air freight capacity is reflected in the news that both Airwork Atlantic and P.A.W.A. have increased the frequency of their all-cargo services from two to three weekly. Airwork's westbound services leave London each Wednesday, Saturday and Sunday evening. Wednesday and Saturday flights are operated with DC-4s and the Sunday service is temporarily flown by DC-6A chartered from Slick Airways (Airwork's own DC-6As are due for delivery next January).

On completion of its Airwork flight to New York the DC-6A continues to Chicago, Los Angeles and San Francisco on a scheduled Slick service, so that British exporters are able to send goods direct to the west coast on a single waybill without trans-shipment.

### W.A.A.C. ACCIDENT INQUIRY

THE following statement on the loss of one of their five Bristol 170 Mk 21s has been issued by West African Airways Corporation:—

"The board of investigation appointed by the Nigerian Minister of Communications and Aviation to inquire into the cause of the accident to the West African Airways Corporation's Wayfarer VR-NAD at Calabar on February 5th, 1955, has stated in its report that the crash was due to structural failure, resulting in detachment of the port mainplane of the aircraft in flight. The report stresses that no blame attaches to the crew or the West African Airways Corporation.

"The preliminary investigation of the crash was carried out on site, followed by further detailed examination of selected wreckage at Lagos Airport, Nigeria. The party conducting the investigation included experts from the Royal Aircraft Establishment, Farnborough, the Air Accident Branch of the British Ministry of Transport and Civil Aviation, and the Bristol Aeroplane Company. The main wreckage of the aircraft fell in dense forest, the mainplane coming to rest three-quarters of a mile back-track from the main wreckage. Final approach to the wreckage was on foot along a single line track involving crossing a number of small streams. Significant parts of the wreckage have been sent to the Royal Aircraft Establishment, Farnborough, for further detailed examination.

"This accident represents a serious set-back to West African Airways Corporation, who prior to the accident were operating a stabilized fleet of Dove and Bristol 170 aircraft with a high degree of efficiency. This was further complicated by the grounding of the Dove aircraft, concurrently with Bristol 170, by the Air Registration Board and the de Havilland Aircraft Company, to enable main-spar fatigue modifications to be embodied on the former. This resulted in complete cancellation of air services within West Africa until specially chartered aircraft of another type became available, these being retained in service with West African Airways for over three months."

### C-BAND RADAR IN DEMAND

FOLLOWING the recently announced decision of United Air Lines to buy C-band airborne radar for their entire fleet, American Airlines announce that they, too, have placed an order with the Radio Corporation of America for this equipment. Initially it will be installed only on American's DC-7s, providing the airline with operational experience of airborne radar over a wide range of conditions. Modification of the 25 DC-7s now in trans-continental service will begin in October and work will continue in 1956 on the 14 additional DC-7s due for delivery next year.

The storm-warning radar developed by R.C.A. weighs 125 lb and has a range of about 100 miles. Cost of the A.A. conversion programme is quoted as £285,000.

## BREVITIES

FORMERLY Director-General of the Civil Aviation Branch of the United Kingdom High Commission in Germany, Mr. P. W. Johnson, D.S.O., O.B.E., D.F.C., A.F.C., has been appointed Civil Air Attaché, Germany, with effect from May 6th last. Mr. H. I. Wood, O.B.E., also formerly with this branch of the High Commission, has been appointed Assistant Attaché.

* * *

The first DC-3 service to be operated by Derby Aviation was completed on May 6th, when G-ANTD made the round trip between Derby and Jersey *via* Wolverhampton and Birmingham. The company, which has used Rapides since the end of the war, plans shortly to introduce DC-3 services to the Isle of Man also.

* * *

The total back-log of civil aircraft on order from the Douglas Aircraft Co. is reported to have reached 210. This figure, correct to May 1st, includes a number of contracts not yet announced by the airlines concerned, and is made up of 15 DC-6As, 57 DC-6Bs, 56 DC-7s and 82 DC-7Cs. Previous announcements gave the total number of DC-7Cs ordered as 48, for delivery to seven airlines. Delivery rate of aircraft in the DC-6/7 series, now seven monthly, is to be stepped up to 13 per month.

* * *

A public inquiry into the accident to B.E.A. Viscount G-AMOK, which was badly damaged at London Airport on January 16th when taking off from a disused runway, will begin at Holborn Town Hall, London, at 10.30 a.m. on June 7th. The inquiry will be held by Mr. A. A. Mocatta, Q.C. His assessors will be Mr. R. W. O'Sullivan, chief inspector of accidents for Eire, and Capt. H. K. Gordon-Burge, a senior captain of Viscounts with Aer Lingus.

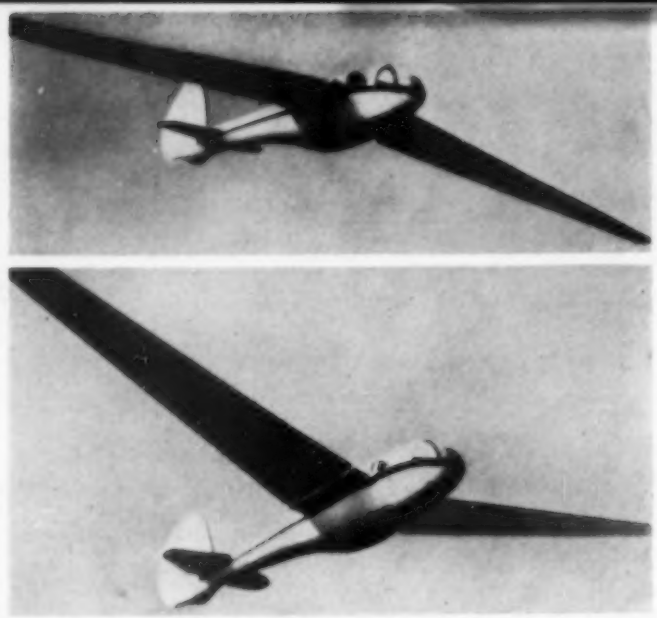
* * *

Informal discussions between British and American civil aviation authorities—dealing with, *inter alia*, questions of route modifications for both United States and United Kingdom air carriers—are being held in Washington this month. Senior British delegate is Sir George Cribbett, K.B.E., C.M.G., Deputy Secretary of the Ministry of Transport and Civil Aviation, who will afterwards attend the International Civil Aviation Organization Assembly at Montreal on May 31st.

* * *

Due for delivery in July, a third Westland-built S-55 helicopter has been ordered for B.E.A. Unlike the two already in service it will not have flotation gear or an exhaust silencer, though provision has been made for these items to be added at short notice. This helicopter will be available as a stand-by aircraft for the scheduled service between London Airport and the South Bank. Its normal function will be twofold; development flying for B.E.A. and trials planned by the Home Office as part of an official investigation into the use of helicopters for civil defence purposes.

# CLUB AND GLIDING NEWS



*These views of Russia's flapping-wing sailplane came to us from the Soviet journal "Wings of the Fatherland" via our U.S. contemporary "Aero Digest." The design, whose principles are not yet available for publication, has been variously attributed to a Ukrainian, Alexander Yrkevich, and to A.U. Manozkow, of Kiev.*

THE recently formed Aircraft Owners and Pilots' Association of South Africa now has over 100 members. Chairman of the association is Dr. J. N. Haldeman, and Mr. Ponie de Wet is secretary; H.Q. are at Mutual Buildings, Church Square, Pretoria. At the inaugural meeting it was decided to adapt the American A.O.P.A. constitution to meet the new association's needs, adding to its purposes the sponsoring of a National Air Commando—a voluntary, semi-military home defence auxiliary. The formal objectives of the A.O.P.A. of South Africa are: —

"(1) Increase safety in non-commercial civil aircraft, (2) Aid and encourage development of aircraft more acceptable to the average South African, (3) Wipe out landing fees and other practices designed to discriminate against the non-commercial flying public, (4) Eliminate unnecessary regulations, and help rewrite those in use so as to make them more practicable, (5) Help wipe out unsound business practices in the aviation industry . . . , (6) Encourage air-marking of every city and town, (7) Help establish single-strip airports for all South African communities, (8) Help increase and improve airport facilities, (9) Help progressive, conscientious airport operators to stay in business, (10) Assure civil flyers fair and proper representation on all Government committees affecting those flyers' welfare, (11) Encourage increased use of civil aircraft for cross-country transportation, (12) Increase recognition of non-scheduled flying by the Government, (13) Establish approved AOPA of South Africa airports, (14) Establish inexpensive landing areas for every South African community."

ALTHOUGH all this season's gliding courses at the Derby and Lancashire Club's site at Camphill, Great Hucklow, are already fully booked, there are still vacancies on those courses listed below. In each case the course fees (which vary from 11½ gns to £26) include flying, instruction, accommodation and food. Unless otherwise stated, beginners are accepted on all courses.

**Bristol Gliding Club,** Lulsgate, Somerset. Weekly courses beginning each Monday from June 6th to October 3rd. Second-week continuations by arrangement. Inquiries to P. Westmoreland, 18 Norley Road, Bristol 7.

**London Gliding Club,** Dunstable, Bedfordshire. June 13-24th, July 18-29th, August 15-26th, September 5-16th, September 26th-October 1st. Course Secretary, London G.C., The Downs, Dunstable, Beds.

**Midland Gliding Club,** Long Mynd, Shropshire. Courses for "B" and "C" certificate holders and qualified power pilots only, June 11-18th, July 2nd-9th, August 13-20th, August 27th-September 3rd. J. W. G. Harnden, 37 Hugh Road, Smethwick 41, Birmingham.

**Scottish Gliding Union,** Balado, Kinross-shire. July 2nd-9th, July 16th-23rd, July 30th-August 6th, August 13-20th, August 27th-September 3rd. Course Secretary, S.G.U., Balado, nr. Milnathort.

**Surrey Gliding Club,** Lasham, Hampshire. May 22nd-28th, June 5-11th, 12-18th, 19-25th, July 3rd-9th, 10-16th, August 21st-27th, August 28th-September 3rd, September 4-10th, 11-17th, 18-24th, September 25th-October 1st. A. F. Gotch, Surrey G.C., Lasham Aerodrome, nr. Alton, Hants.

**Yorkshire Gliding Club,** Sutton Bank, Yorkshire. June 12-18th, June 26th-July 2nd, July 10-16th, July 24-30th, August 7-13, August 21st-27th, September 4-10th. The Secretary, Yorkshire G.C., Sutton Bank, Thirsk, N. Yorks.

In addition to the British clubs, a number of foreign gliding schools and centres organize courses for which British glider pilots are eligible. Details of a number in France, Austria, and at the famous Wasserkuppe site in Germany are available from the British Gliding Association at Londonderry House, 19 Park Lane, London, W.1.

THE Pioneer Flying Club, mentioned on this page last week, now report that Blackbushe, not Farnborough, is to be the site of their weekday flying (in addition to Croydon at weekends).

## DEUTSCHE LUFTHANSA IN SERVICE (continued from p. 697)

is 640ft wide and there is only one internal support; this is set well back from the door, so that there is adequate room for manœuvring aircraft. The floor is heated to 25 deg C (77 deg F) and, with an outside temperature of −20 deg C (−4 deg F) and the doors open, the interior can be kept at 16 deg C (61 deg F). Numerous pick-up points in the floor of the hangar and on the apron outside supply water, electricity and compressed air.

With one Super Constellation lurking in one corner and two Convairs and a DC-3 at the opposite end the hangar looked virtually empty. Workshops and stores are situated behind the rear wall of the structure and in these the company is undertaking all its maintenance and overhauls, including those of engines, radio and instruments. Above the aircraft and engine workshop are offices, instrument shops and the Link room.

During this summer D.L.H. will operate Convairs on daily services from Hamburg to London *via* Düsseldorf and from Munich to London *via* Frankfurt. There are thrice-weekly flights from Hamburg to Paris *via* Frankfurt and twice-weekly services between Hamburg and Madrid *via* Wahn and Frankfurt. The Munich - London services offer connection with the outward Paris and Madrid flights at Frankfurt but the return connections are not particularly convenient. These operations can be done with three Convairs, leaving one in reserve. The approximate weekly fleet utilization will be about 36 hr 45 min per aircraft.

On June 8th Lufthansa will begin its North Atlantic operations and by July 9th there will be six flights in each direction every week between Hamburg and New York. All flights will call at Shannon, three will serve Frankfurt and three Düsseldorf. Gander will be used as a refuelling stop when necessary but the 18 hr endurance of the L-1049Gs to be used should make direct Shannon - New York flights possible on a high percentage of occasions.

Three of the Super Constellations have already been delivered and they are engaged on training duties. In service they will be commanded by T.W.A. captains, and will have Lockheed flight engineers and Transocean Air Lines navigators.

The galleys in the L-1049Gs have been designed by Lufthansa and built in Germany by Sell of Herborn. I saw this type of galley in the fully working mock-up of this section of an L-1049G which is used for cabin crew training. It appears to be well thought out, and it has been so designed that all food and drink for a flight from Hamburg to Rio can be loaded in Hamburg.

Accommodation on the Super Constellations will be for 20 standard and 45 tourist passengers in summer and 16 standard and 40 tourist in winter.

Lufthansa's future plans include the operation of services to Buenos Aires and Teheran. The routings have not been settled but it has been decided to use the Super Constellations on the Teheran route as well as on the transatlantic services.

On my return flight in D-ACOH the British captain was K. T. Quirke and, in addition, Capt. J. Monro was flying in the jump seat to check out co-pilot D. Lindner on a V.D.F. approach to Düsseldorf. The screen used to block the view from the right-hand seat for instrument training is an interesting design which allows the pilot on the left to retain the use of the whole screen. Capt. Monro was very much in favour of using the jump seat and checking the normal crew procedure, rather than having the check pilot fly as captain. The jump-seat method has been tried recently by B.E.A. on Viscounts and it may be adopted by the Corporation as standard procedure.

*The Navy that flies: Two impressive shots of an aerobatic foursome on Sea Venoms of No. 890 Squadron, R.N., which is commanded by Lt-Cdr. A. Gordon-Johnson, R.N., and based at Yeovilton, Somerset.*

# SERVICE AVIATION

*Royal Air Force and Fleet Air Arm News*

### Attackers for R.N.V.R.

THE Admiralty has announced its intention to re-equip the fighter squadrons of the R.N.V.R. with Supermarine Attackers, which will replace the present Sea Furies.

No. 1831 Squadron of the Northern Air Division at Stretton will be the first to have the new aircraft, and the whole of the annual continuous training period is to be devoted to conversion. Before flying the Attackers the pilots will take a short course on Vampire T.22s.

The Northern Air Division is commanded by Cdr. R. I. Gilchrist, M.B.E., R.N.V.R.; and Lt-Cdr. P. L. V. Rougier, R.N.V.R., commands No. 1831 Squadron.

### No. 60 Squadron Standard

AT a ceremony held in Singapore on Friday, May 6th, Air Chief Marshal Sir John Baker, G.B.E., K.C.B., M.C., D.F.C., presented a Squadron Standard to No. 60 Squadron.

In his address after the presentation Sir John first pointed out that today the Royal Air Force carries a greater responsibility than ever before in the defence of the country and Commonwealth; and he went on to express the belief that "if we can make our contribution in the proper way we may have the power in our hands to prevent another war."

Sir John is an old member of No. 60, and at the close of his address surprised his listeners when he turned to his son, F/O. G. Baker, who was acting as A.D.C. to his father and is at present serving in Malaya, and took from him a silver cigarette box which he held aloft. "I was married from your squadron in 1927, when I was a flight lieutenant," he said. "My wife and I had an inscription engraved on this, your wedding gift to us. We will be most pleased if you will allow us to present it back to the squadron. The two inscriptions measure the span of history through which we have lived." The gift was acknowledged by the commanding officer, S/L. A. D. C. Webbe.

### A.E.W. Flight for R.C.N.

FOUR Grumman Avengers of the Royal Canadian Navy have been modified as airborne early-warning aircraft and will operate as a flight of No. 881 Squadron, R.C.N., either from H.M.C.S. *Shearwater*, the R.C.N. air station at Dartmouth, N.S., or at sea from the carrier H.M.C.S. *Magnificent*.

A.E.W. aircraft have been in use in the Royal Canadian Navy for some time past, but only in a training capacity.

### Transport Command S.T.S.O.

THE appointment is announced of A. Cdre. C. E. Hartley as Senior Technical Staff Officer at H.Q. Transport Command.

A. Cdre. Hartley has specialized as an engineering specialist and has held a wide variety of technical posts.

### "At Homes" Raise £23,774

AS the result of the opening of 56 Royal Air Force stations to the public on September 19th 1954, during Battle of Britain Week, the sum of £23,774 was raised for R.A.F. charities. The money has been passed in equal shares to the Royal Air Force Benevolent Fund and the Royal Air Forces Association. Last year 1,200,000 people—a record figure—visited the stations.

### Helicopter Minesweeper

IN the illustration below is shown a Whirlwind helicopter equipped with a hook device for minesweeping. The equipment was developed and constructed to a Ministry of Supply specification by Westlands for experimental use by the Royal Navy.

Security considerations preclude the publication of any details of operation, but it will be recalled that the United States Navy recently announced that a helicopter minesweeping device had been developed.

### Search and Rescue, 1954

RESCUE operations involving aircraft were carried out on nearly 300 occasions during 1954 and R.A.F. Commands in all parts of the world, co-operating with the Fleet Air Arm, the Royal Navy and the U.S.A.F., saved several score of lives of the 250 involved in air and land mishaps. Many more were also saved by assistance given during marine incidents.

From the coasts of the British Isles, R.A.F. launches put to sea 38 times. More than 50 different types of Service and civil aircraft took part in rescue operations, and over 2,700 hours were flown in more than a thousand sorties—567 in Britain and 472 abroad. In Britain, Shackletons flew the lion's share of piston-engined rescue sorties, 94 in all, and R.A.F., R.N. and U.S.A.F. helicopters made more than 80

*Equipped for minesweeping: The experimental WS-55 referred to on this page.*

*Canberras of No. 21 Squadron at Khormaksar during their recent visit to Aden. With them are the Aden Levies, the only R.A.F. unit now to have Camels—but not of the Sopwith variety.*

## SERVICE AVIATION...

sorties. R.A.F. Meteors went out 110 times. The majority of the rescue work in the Middle and Far East was done by Valettas (98 sorties) and Shackletons (29 sorties).

During 1954, an R.A.F. mountain rescue team was formed in Cyprus; so far, their greatest difficulty has been attack by eagles.

Coastal Command aircraft have often taken part in rescue operations for merchant ships in distress. When the Danish liner *Kronprincesse Ingrid* caught fire in the North Sea, an R.A.F. Neptune was the first on the scene and homed surface craft to her. A Shackleton also escorted a civil airliner in distress to Prestwick.

Sunderlands have done good work in the Far East, one of them circling over a drifting Japanese merchantman until the vessel was taken in tow. On another occasion, a native launch was reported adrift off Singapore. A Sunderland took off from Seletar, found the launch within 14 minutes, and put down alongside. It transferred a doctor by rubber dinghy and then passed a tow-line and spent the next eight hours towing the launch safely into harbour.

R.A.F. Valettas, Hornets and a Sunderland took part in the rescue of the passengers of the Argonaut which was shot down off the South China coast last year. The passengers were finally picked up by a U.S.A.F. SA-16 Albatross.

### Two Awards

THE Queen has been graciously pleased to approve the award of the M.B.E. (Mil. Div.) to F/L. E. D. Campbell and of the George Medal to Cpl. J. R. Saunders, both of No. 95 Maintenance Storage Unit, Lords Bridge, Cambridgeshire.

These awards are in connection with a fire which broke out following the explosion of an underground container of mustard gas. F/L. Campbell, protected only by a respirator, dashed into the toxic smoke to search for casualties and to help in preventing the spread of flames and poison gas.

The citation for the George Medal says that Cpl. Saunders as N.C.O. in charge of fire-fighting led his party to the scene of the accident and fought his way through the smoke and debris to the tank. Despite the fierce blaze, with smoke and poisonous fumes belching up to 200ft, he maintained his position for 30 minutes within a few feet of the crater, directing a steady stream of foam on to the tank until the flames subsided. The citation ends: "Cpl. Saunders displayed complete disregard for his own safety and selfless devotion to duty and his action constituted a magnificent example of leadership, personal bravery and skill of the most superb order."

### Athens Air Attaché

AFTER having been Senior Personnel Staff Officer at Flying Training Command since last summer, Act. A. Cdre. J. C. Roberts, C.B.E., has been appointed air attaché at Athens.

This is A. Cdre. Roberts's second spell of duty as an air attaché: between 1946 and 1948 he was at Rio de Janeiro.

### Dunning Cup

THE Dunning Memorial Cup, awarded to the R.A.F. unit achieving the highest marks at the Joint Anti-Submarine School training course, has been won by No. 38 Squadron (Avro Shackletons), commanded by W/C. D. E. Hawkins, D.F.C. The unit is normally based in Malta.

### A.O.P.9 Figures

IT has now been established that the Auster A.O.P.9 has, in spite of its being a full three-seater, a considerable "edge" on its predecessor, the Mk 6, in the matter of take-off and landing performance. The actual figures obtained during trials are as follow: A.O.P.9 at 2,125 lb (normal operational load) in 5 m.p.h. wind, take-off run 110 yd and total distance to clear 50ft, 225 yd; Mk 6 at 2,100 lb in 5 m.p.h. wind, take-off run 127 yd and total distance to 50ft, 285 yd.

*A comparative photograph of the two Austers referred to above: A.O.P.9 nearest the camera.*

### Bomber Command Trophies

AT a ceremony held at Upwood yesterday, Air Chief Marshal Sir Guy Garrod was due to present the following Bomber Command trophies: Efficiency Trophy, for best all-round squadron, No. 115 Squadron; Laurence Minot Trophy (this will become the Senior "V" Force Trophy), best Lincoln squadron in H2S bombing, No. 7 Squadron; Geoffrey Salmond Trophy, best individual Lincoln crew in H2S bombing, No. 83 Squadron; Special Award, best all-round crew in annual bombing competition, No. 7 Squadron; Armament Officers Trophy, best Canberra squadron in Gee-H and visual bombing, No. 10 Squadron; Camrose Trophy, best Canberra Squadron in visual bombing, No. 9 Squadron; Gee-H Bombing Trophy, best individual crew in Gee-H bombing, No. 139 Squadron; Aircraft Efficiency Trophy, station with best aircraft servicing record for year, Binbrook; M.T. Efficiency Trophy, station with best M.T. servicing record for year, and M.T. Accident Prevention Trophy, station with lowest M.T. accident rate for year, Marham.

### Combined Operations in Malaya

CANBERRA, Valetta, Pioneer and Auster aircraft and Sycamore helicopters of the Far East Air Force Squadrons, together with S-55 Naval helicopters, have so far successfully undertaken their missions as part of operation "Unity"—code name of the hunt on the Malaya-Thailand border for Chin Peng, secretary-general of the Malayan Communist Party, with members of his staff and bodyguard.

Canberras of No. 101 Squadron (S/L. W. D. Robertson) detachment have bombed an encampment on the borders of Kedah State and Siam and also carried out attacks against terrorists previously contacted.

Valettas of No. 48 Squadron (S/L. B. V. Kerwin) dropped paratroops into Northern Kedah to prepare landing zones for Naval helicopters, bringing in troops of the Royal Scots Fusiliers, and subsequently kept these ground forces going with the accurate despatch of supply packs.

Pioneer aircraft of No. 267 Squadron (S/L. T. W. G. Godfrey) have carried the commanders of the Federation security forces and the Thai forces on reconnaissance flights in the operational area and on visits to their troops on the ground.

Austers of No. 656 A.O.P. Squadron have been carrying Federation and Thai police forces on reconnaissance flights of the area. S-55 helicopters of No. 848 Royal Naval Air Squadron have been shuttling ground forces in and out of the area and Sycamores of No. 194 Squadron (S/L. C. R. Turner, A.F.C.) have been standing by for casualty evacuation flights.

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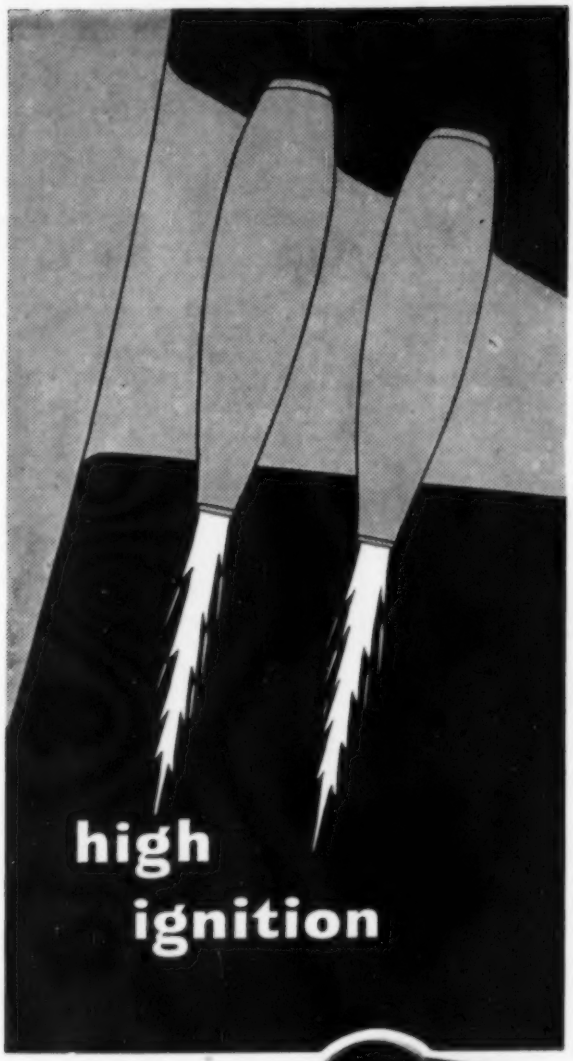


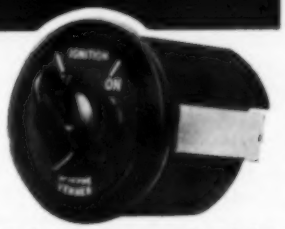


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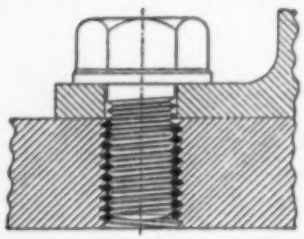

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## PATENTS

THE proprietor of British Patent No. 668805, entitled "Improvements in Vibratory Aircraft Alarms of the Rotary Eccentric Weight Type," offers same for licence or otherwise to ensure its practical working in Great Britain. Inquiries to Singer, Stern & Carlberg, Chrysler Building, New York 17, N.Y., U.S.A. [3680

THE Proprietor of British Patent No. 650,322 for "Improvements in Folding Wings for Aircraft," desires to enter into negotiations with a firm or firms for the sale of the patent or for the grant of licences thereunder. Further particulars may be obtained from Marks & Clerk, 57 & 58 Lincoln's Inn Fields, London, W.C.2. [3724

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## PUBLIC ANNOUNCEMENTS

### AIR TRANSPORT ADVISORY COUNCIL

THE Air Transport Advisory Council give notice that they have received the undermentioned applications to operate scheduled air services:

FROM East Anglian Flying Services, Ltd., of Southend Airport, Southend-on-Sea, Essex:

APPLICATION No. 477 for a Seasonal Inclusive Tour Service with D.H. Dove and Dakota aircraft in conjunction with Tartan Arrow (Continental), Ltd., for the carriage of passengers and supplementary freight between Southend and Nice at a frequency of from two to seven services weekly during the season from May to October inclusive each year, for a period of 10 years, commencing 1st May, 1956.

APPLICATION No. 478 for a Seasonal Inclusive Tour Service with D.H. Dove and Dakota aircraft in conjunction with Tartan Arrow (Continental), Ltd., for the carriage of passengers and supplementary freight between Southend and Palma at a frequency of from two to seven services weekly during the season from May to October inclusive each year, for a period of 10 years, commencing 1st May, 1956.

THESE applications will be considered by the Council under the Terms of Reference issued to them by the minister of Civil Aviation on 30th July, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3, Dean's Yard, London, S.W.1, from whom further particulars of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections.

THE Air Transport Advisory Council also give notice that the following application has now been withdrawn:

APPLICATION No. 472 from Manx Airlines, Ltd., of Ronaldsway Airport, Isle of Man, for a Normal Scheduled Service between the Isle of Man (Ronaldsway) and Bergen (Flesland) with an intermediate traffic stop at Newcastle (Woolsington) with Dakota and Viking aircraft, which was advertised in "The Aeroplane" and "Flight" on 8th April, 1955. [3742


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| Port | 70 |
| Port since complete | 70 |
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| Starboard since complete | 70 |

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The applicant should be of H.N.C. or Degree Standard and have had 1 or 2 years' experience in Industry.

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